# 中華農業研究

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# CHECK LIST AND HOST PLANT INDEX TO SCALE INSECTS OF TAIWAN, REPUBLIC OF CHINA [1]

*by* Charles Chia-chu Tao [2]

## Introduction

Scale insects of Taiwan had been studied by Drs. Green, Chamberlin, Ferris, Takahashi and Takagi. Their publication scattered in different Journals and Countries since 1923 to 1970. However, the specimens were deposited in our collection and a part of them in the collection of College of Agriculture, University of Hokkaido, Japan.

The present paper is only to record the place of original description or first record from Taiwan, synonyms, host plants and localities under each species. The arrangement is according to the newest system of Coocoidea and 12 familes, 101 genera and 314 species were recorded. Host plant index is also included.

The compiler wishes to express his sincere thanks to Mrs. S. C. Chiu, Wan Head of Department of Applied Zoology and Mr. K. S. Lin, Curator of Insect Collection in various ways of advices without their helps the check list could not be completed.

## Family ACLERIDAE

### Genus ***Aclerda*** Signoret 1874

Ann. Soc. Ent. France (Ser. 5) 4 : 96. Type : *Aclerda subterranea* Signoret 1874.

***A. sacchari*** Teague 1925

Ann. Ent. Soc. Amer. 18 : 439, figs. ; Takahashi 1930 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 136, *A. japonica.*

Syn. : *A. japonica* Takahashi nec Newstead 1901, *A. caminensis* Hempl 1934, *A. thysanolaenae* Mamet 1943.

Host : *Saccharum officinarum.*

Locality record : Hsinhua.

## Family ASTEROLECANIIDAE

### Genus ***Anomalococcus*** Green 1902

Ent. Mag. 38 : 261. Type : *Anomalococcus cremastogastri* Green 1902.

***A. multipori*** Morrison 1921

Philip. J. Sci. 18 : 641, fig.

Host : *Glochidon* sp.

Locality record : Taipei, Kenting.

### Genus ***Asterolecanium*** Targioni-Tozzetti 1868

Intr. 2nd Mem Studi Cocc. Catalogue : 41 ; Ferris 1955 Atlas Scale Insects N. Amer. 7 : 15. Type : *Coccus aurens* Boisduval 1868.

Syn. *Asterodiaspis* Signoret 1871, *Planchonia* Signoret 1870, *Bambusaspis* Cockerell 1902.

***A. bambusae*** (Boisduval 1869)

Insect Agric. 3 : 261, *Chermis* ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 47, *Asterolecanium.*

Hosts : *Bambusa stenostachya, B.* sp.

Locality record : Taipei, Yuanshan, Chushan, Wushe, Chiayi.

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1. Contribution No. 832 from the Taiwan Agricultural Research Institute.
2. Entomologist of Taiwan Agricultural Research Institute, Wufeng, Taichung Hsien, Taiwan, Republic of China

***A. bambusicola*** Kuwana 1916

Annot. Zool. Japan 9 : 146 ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 49 ; Takahashi 1928 Philip. J.Sci. 36 : 339, *A. bambusae* var. *tuberculata* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 46, *tuberculatum*.

Syn. : *Asterolecanium tuberculatum* Takahashi 1929

Host : *Bambusa*.

Locality record : Taipei.

***A. corallinum*** Takahashi 1928

Philip. J. Sci. 36 : 339, fig., *corallinus*; Russell 1941 U. S. D. A. Misc. Publ. 424 : 71.

Hosts : *Psychotria reevesii*, *Sideroxylon* sp.

Locality record : Keelung, Taipei, Shihlin.

***A. coronatum*** Green 1909

Coccidae Ceylon : 327, pl. 74 ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 72.

Host : *Bambusa stenostachya*.

Locality record : Taipei.

***A. horishae*** Russell 1941

U. S. D. A. Misc. Publ. 424 : 106 ; Takahashi 1934 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 4, *japonica* Cockerell.

Syn. : *A. japonicum* Takahashi 1934 nec Cockerell.

Hosts : *Lithocarpus* sp., *Quercus* sp.

Locality record : Hsintien, Shuishe.

***A. machili*** Russell 1941

U. S. D. A. Misc. Publ. 424 : 125.

Host : *Machilus* sp.

Locality record : Yangmingshan.

***A. miliaris*** var. ***rubsutum*** Green 1908

India Dept. Agr. Mem Ent. 2 : 19 ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 130.

Host : Bamboo.

Locality record : Erhshui.

***A. minutum*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 10 ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 135.

Host : *Bambusa stenostachya*.

Locality record : Taipei, Pingtung.

***A. pasaniae*** Kuwana and Cockerell 1909

N. Y. Ent. Soc. J. 17 : 154 ; Russell 1941 U. S. D. A. Misc. Publ. 424 : 149.

Hosts : *Lithocarpus uraiana*, *Cyclobalanopsis glauca*.

Locality record : Taipei, Hsintien, Wulai.

***A. pseudolanceolatum*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60, 34 ; Russell 1941 U. S. D. A. Misc. Publ. 424 ; 158.

Host : *Bambusa*.

Locality record : Taipei, Pintung.

***A. pseudomiliaris*** Green 1922

Bombay Nat. Hist. Soc. J. 28 : 1036 ; Russell U. S. D. A. Misc. Publ. 424 : 160.

Host : Bamboo.

Locality record : Erhshui.

***A. psychotriae*** Russell 1941

U. S. D. A. Misc. Publ. 424 : 162.

Host : *Psychotria* sp.

Locality record : Wulai.

***A. suishae*** Russell 1941

U. S. D. A. Misc. Publ. 424 : 203.

Host : *Quercus* sp.

Locality record : Erhshui.

## Family CEROCOCCIDAE

### Genus ***Cerococcus*** Comstock 1882

For U. S. D. A. Corn. Agr. Rept. 1881—1882 : 213 ; Type : *Cerococcus quercus* Comstock 1882.

Syn. : *Solenococcus* Cockerell 1889, *Solenophora* Maskell 1890, *Ceriococcus* Mahdihassan 1933, *Antecerococcus* Green 1901.

***C. ficoides*** Green 1899

Ent. Mon. Mag. 2, 10 : 225 ; Ferris 1921 Bull. Ent. Res. 12 : 212 ; Takahashi 1928 Phil. J. Sci. 36 : 339.

Hosts : *Camellia sinensis, Ficus, Gardenia florida, Mallotus japonicus.*

Locality record : Taipei, Pingtung.

***C. ornatus*** Green 1909

Coccidae Ceylon : 306, pl. 115.

Host : *Psychotria* sp.

Locality record : Shihlin.

## Family COCCIDAE

### Genus *Ceroplastes* Gray 1828

Spidilegia Zoologica : 7, pl. 3, figs. 6—7 ; Green 1904 Coccidae Ceylon : 268. Type : *Coccus(Ceroplastes)janeirensis* Gray 1828.

***C. ceriferens*** (Anderson 1791)

Mon. Cocc. *Coccus ceriferi* ; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 83, *Ceroplastes* ; Maki 1916 Rept. Stud. Mulberry Ins. : 50 ; Takahashi 1928 Philip. J. Sci. 36 : 345 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 68.

Syn. : *Ceroplastes chiliensis* Gray 1830, *C. australiae* Walker 1852, *Gascardia cerifera* (Anderson) De Lotto 1965.

Hosts : *Artemisia capillaris, Camellia chinensis, Citrus* spp., *Ficus retusa, Ixora chinensis, Mangifera indica, Melastoma candidum, Morus alba, Persea gratissima, Polygonum chinensis, Pometia pinnata, Pygeum preslii, Rhodomyrtus tomentosa.*

Locality record : Taipei, Tanshui, Yangmingshan, Hsinchu, Chiayi, Kenting, Lanhsu.

***C. floridensis*** Comstock 1881

U. S. D. A. Rept. 1880 : 331; Takahashi 1928 Philip. J. Sci. 36 : 345 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 67.

Hosts : *Artocarpus* sp., *Calophyllum inophyllum, Camellia sinensis, Carissa carandas, Citrus* spp., *Diospyros discolor, Eriobotrya japonica, Gardenis florida, Machilus* sp., *Maesa sinensis, Mangifera indica, Poncirus trifoliata, Psidium guyava. Psychotria elliptica, Rhodomyrtus tomentosa, Schima confertiflora, Ternstroemia japonica.*

Locality record : Ilan, Taipei, Yuanshan, Shihlin, Hsinpu, Puli, Chiayi, Kenting.

***C. rubens*** Maskell 1892

Trans. N. Z. Inst. 25 : 214 ; Takahashi 1928 Philip. J. Sci. 36 : 345 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 67.

Syn. : *Ceroplastes myricae* Green 1900 nec Linnaeus.

Hosts : *Calophyllum inophyllum, Cinnamomum zeylanicum, Citrus* spp., *Eugenia jambos, Euphoria longana, Garcinia spicata, Mangifera indica. Myristica heterophylla, Palaquium formosanum, Persea gratissima.*

Locality record : Taipei, Haintien, Hsinpu, Changhwa, Yuechih, Shuishe, Erhshui, Chiayi, Pingtung, Kenting.

### Genus *Ceroplastodes* Cockerell 1893

Ent. 26 : 350 : Type : *Fairmairia nivea* Cockerell 1893.

***C. chiton*** Green 1909

Coccidae Ceylon : 287, pl. 109 ; Takahashi 1928 Philip. J. Sci. 36 : 345 ; 1929 Dept. Arg. Gov't. Res. Inst. Formosa Rept. 40 : 68.

Host : *Ficus retusa.*

Locality record : Taipei, Keelung, Yuanshan, Tanshui.

### Genus *Coccus* Linnaeus 1758

Syst. Nat. ed. 10, 1 : 455—457. Type : *Coccus hesperidum* Linnaeus 1758.

Syn. *Calypticus* Costa 1835, *Calymnatus*

Costa 1840. *Lecanium* Burmeister 1835.

*C.* ***acuminatus*** (Signoret 1873)

Ann. Soc. Ent. France 5, 3 : 397, *Lecanium acuminatum* ; Takahashi 1928 Philip. J. Sci. 36 : 341, *Coccus acuminatus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 52 ; 1959 Kontyu 27, Esaki Mem. Issue : 75, *Platycoccus.*

Syn. : *Platycoccus acuminatus* (Takahashi 1959) . *Habibius acuminatus* Ezzat and Hussein 1967, *Kilifia acuminatus* ( De Lotto) 1965

Hosts : *Gardenia florida, Ardisis* ( *Bladhia*) , *Psychotria serpens.*

Locality record : Shinlin, Kuantzuling.

*C.* ***acutissimus*** (Green 1896)

Ind. Mus. Notes 4 : 10, *Lecanium acutissimum* ; Takahashi 1928 Trans. Nat. Hist. Soc. Formosa 18 : 259, *Coccus acutissimus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 53.

Hosts : *Artocarpus integrifolia, Euphoria longana, Eugenia jambos, Michelia longifolia, M.* sp.

Locality record : Erhshui, Shuishe, Yuechih, Puli, Chiayi, Kueitzuchiao, Wushe.

*C.* ***bicurciatus*** (Green 1904)

Coccidae Ceylon : 214. *Lecanium* ; Takahashi 1928 Philip. J. Sci. 36 : 341, *Coccus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 53.

Host : *Murraya exotica.*

Locality record : Taipei.

*C.* ***caudaus*** (Green 1896)

Ind. Mus. Notes 4 : 10, *Lecanium* ; 1904 Coccidae Ceylon : 223 ; Takahashi 1928 Philip. J. Sci. 36 : 341, *Coccus* ; 1929 Dept. Agr. Gov't. Res. Formosa Rept. 40 ; 53.

Host : unknown.

Locality record : Fengyuan.

*C.* ***elongatus*** (Signoret 1873)

Ann. Soc. Ent. France 5, 3 : 404, *Lecanium elongatum* ; Takahashi 1928 Philip. J. Sci. 36 : 342, *Coccus* ; 1929 Dept, Agr. Gov't. Res. Inst. Formosa Rept. 40 : 52 ; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 73, *Lecanium longulum* ; Takahashi 1955 Trans. Shikoku Ent. Soc. 4 : 69, *C. celticum* Kuwana.

Syn. : *Lecanium acaciae* Newstead 1917, *Lecanium longulum* Douglas, *L. kraunhiarum* Lindinger 1928, *L. vistariae* Brain 1920.

Hosts : *Acacia confusa, Anona montana, A. squamosa, Areca catechu, Calliandra haematocephala, Calophyllum inophyllum, Casuarina equisetifolia, Citrus* spp., *Codiaeum variegatum, Derris laxiflora, Erythroxylum coca.* var. *spruceanum, Ficus retusa, Goniothalamus longifolia, Hibiscus rosasinensis, Milletia nitida Morus alba, Myrica rubra, Litchi chinensis, Osmanthus fragrans, Pitihecolobium dulce, Pometia pinnata, Rhus* sp., *Vitis vinifera.*

Locality record : Taipei, Yuanshan, Shihlin, Miaoli, Tuniu, Puli, Changhua, Chiayi, Pingtung. Fangliao, Oulaunpi, Kenting, Hualien, Yuli, Taitung, Lanshu.

*C.* ***hesperidum*** Linnaeus 1758

Syst. Nat. ed. 10 : 455 ; Takahashi 1928 Philip. J. Sci. 36 : 341 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 50.

Syn. : *Lecanium signiferum* Green 1904, *L. punctuliferum* Green 1904, *Coccus mauritiensis* Mamet 1936.

Hosts : *Agaue rigida, A.* sp., *Areca oleracea, Bauhinia alba, Callicarpa formosana, Calophyllum inophyllum, Camellia japonica, Carica papaya, Citrus* sp., *Cocos nucifera, Ehretia* sp., *Eriobotrya japonica, Euphoria longana, Gardenia florida, Glohidon puberum, G.* sp., *Mallotus philippinesis, Mangifera indica,*

*Michelia alba, M. longiforlia, Milletia nitida, Rhodea japonica, Rhus vernicif-lura, Terminabia catappa, Terminalia chebula.*

Locality record : Taipei, Keelung, Hsintien, Ilan, Shihting, Sanhsia, Pingting, Erhshui, Yuechih, Puli, Changhua, Chiayi, Tainan, Fengshan, Kenting,

***C. iceryi*** (Guerin-Meneville 1862)

Le Pou a Poche Blanche Berg, Soc. d' Acclim 9 : 939, *Pulvinaria* ; Takahashi 1932 J. Soc. Trop. Agr. Formosa 4 : 45, *Coccus takanoi.*

Syn. : *Pulvinaria elongata* Newstead 1917, *C. takanoi* Takahashi 1932.

Host : *Saccharum officinarum.*

Locality record : Hsinhua

***C. mangiferae*** (Green 1889)

Ent. Mon. Mag. 25 : 249, *Lecanium* ; Takahashi 1928 Philip. J. Sci. 36 : 341 ; *Coccus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 52.

Syn. : *Lecanium wardi* Newstead 1917.

Hosts : *Citrus* spp. *Mangifera indica, Palaquium formosanum, Psychotria elyptica.*

Locality record : Taipei, Chiayi.

***C. scolopiae*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 35, figs.

Host : *Scolopia oldhamii.*

Locality record : Ouluanpi

***C. viridis*** (Green 1889)

Ent. Mon. Mag. 25 : 248, *Lecanium viride* ; Takahashi 1928 Philip. J. Sci. 36 : 341, *Coccus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 51.

Syn. : *Lecanium viride* var. *africanum* Newstead 1898.

Hosts : *Achros sapota, Aegle marmelos, Carissa carandas, Citrus* spp., *Clausena lunulata, Coffea arabica, Gardenia florida, Genipa americana, Heritiera littoralis, Ixora chinensis, Plumeria acutifolia, Psidium guyava.*

Locality record : Taipei, Keelung, Changhua, Yuechih, Erhshui, Chiayi, Fengshan, Pingtung.

Genus ***Eriochiton*** Maskell 1887

Trans. N. Z. Inst. 19 : 46. Type : *Eriochiton hispidum* Maskell 1887.

***E. formosae*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 64.

Host : *Gloichidion* sp.

Localiy record : Taitung.

***E. theae*** Green 1900

Ind. Mus. Notes 5 : 10.

Host : *Camellia chinensis.*

Locality record : Pingchien

Genus ***Eucalymnatus*** Cockerell 1901

Can. Ent. 33 : 57. Type : *Lecanium tessellalum* Signotet 1873.

***E. tessellatus*** (Signoret 1873)

Ann. Soc. Ent. France 5, 3 : 401, *Lecanium tessellatum* ; 1928 Takahashi Philip. J. Sci. 36 : 343, *Eucalymnatus tessellatus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 56.

Syn. : *Lecanium perforatum* Newstead 1902, *L. subtessellatum* Green 1904.

Hosts : *Aglaia formosana, Calophyllum inophyllum, Cinnamomum zeylanicum, Cocos nucifera, Euphoria longana, Ficus elastica, Heritiera littoralis, Machilus* sp., *Mangifera indica, Palaquium formosana, Psidium guyava.*

Locality record : Taipei, Shihlin, Taichung, Erhshui, Shuishe, Changhua, Chiayi, Chuchi, Hsinhua, Fengshan, Kenting.

Genus ***Inglisia*** Maskell 1897

Trans. N. Z. Inst. 11 : 213. Type : *Inglisia patella* Maskell 1897.

***I. formosana*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 34.

Host : *Pirus serotina.*

Locality record : Shihlin.

Genus ***Lecanopsis*** Targioni-Tozzetti 1868

Atti. Soc. Ital. Sci. Nat. 11 : 729. Type : *Lecanopsis rhyzophila* Targioni-Tozzetti 1868.

***L. sacchari*** Takahashi 1928

Philip. J. Sci. 36 : 345 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 67.

Hosts : *Miscanthus* sp., *Saccharum officinarum.*

Locality record : Taichung.

Genus ***Neoplatylecanium*** Takahashi 1929

Dept. Agr. Govt. Res. Inst. Formosa Rept. 40 : 53. Type : *Neoplatylecanium cinnamomi* Takahashi 1929.

***N. cinnamomi*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 54.

Host : *Cinnamomum* sp.

Locality record : Kenting.

Genus ***Paracardicoccus*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 6. Type : *Paracardicoccus actinodaphnis* Takahashi 1935.

***P. actinodaphnis*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 6.

Host : *Actinodaphne mushaensis.*

Locality record : Suo.

Genus ***Paralecanium*** Cockerell 1899

Industrialist 25 : 227. Type : *Lecanium frenchii* Maskell 1891.

***P. expansum*** (Green 1896)

Ind. Mus. Notes 4 : 1 ; Coccidae Ceylon : 235, *Lecanium* ; Takahashi 1928 Philip. J. Sci. 36 : 343, *Paraleccnium* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 57.

Hosts : *Ficus retusa, Machilus* sp., *Myrica rubra.*

Locality record : Taipei, Shihlin.

***P. machili*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 37.

Hosts : *Machilus* sp., *Cinnamomum* sp.

Locality record : Kenting.

Genus ***Protopulvinaria*** Cockerell 1894

J. Trinidad Nat. Club 1 : 309. Type : *Pulvinaria (Protopulvinaria) pyriformis* Cockerell 1894.

***P. pyiformis*** (Cockerell 1894)

J. Trinidad Nat. Club 1 : 309, *Pulvinaria (Protopulvinaria)* ; Takahashi 1933 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 39, *Protopulvinaria agalmae* ; 1955 Annot Zool. Jap. 28 : 36, fig. =*agalmae* Takahashi 1933.

Hosts : *Agalmae lutehnense, Elaeocarpus elliptica.*

Locality record : Taipei, Hsintien.

Genus ***Pulvinaria*** Targioni-Tozzetti 1867

R. Acad. dei Georg Atti(N. S.)13 : 146 ; Steinweden 1946 Microentomology 11 : 1—3 ; Takahashi 1955 Kontyu 23 : 148—154. Type : *Coccus vitis* Linnaeus 1758

***P. durantae*** Takahashi 1931

Trans. N. H. Soc. Formosa 21 : 1.

Host : *Duranta repens.*

Locality record : Taipei, Chiayi.

***P. maxima*** Green 1904

Ent. Mon. Mag. 40 : 205.

Syn. : *P. thespesiae* Green 1909.

Hosts : *Boehmeria* sp., *Glochidin* sp, *Morus* sp.

Locality record : Hsinchu, Tungshih, Kenting, Taitung.

***P. neocellulosa*** Takahashi 1940

Mushi 13 : 24.

Hosts : *Evodia merrillis, Murraya*

*exotica*.

Locality record : Taipei.

***P. polygonata*** Cockerell 1906

Proc. Davenport Acad. Sci. 10 : 131 ; Maki 1915 Foret Expt. Sta. Formosa Rept. 1 : 24, *Pulvinaria aurantii* Maki nec Cockerell, Nitobe 1916 Rept. Stud. Citrus Insects Formosa 44, 51, *Orthezia insignis* Shiraki nec Douglas ; Shiraki 1913 Agr. Expt. Stat. Formosa Spec. Rept. 8 : 104 ; Takahashi 1928 Philip. J. Sci. 36 : 344 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 61.

Hosts : *Citrus* spp., *Murraya exotica*.

Locality record : Taipei, Hsinchung, Hsinchu, Chiayi, Pingtung, Taitung.

***P. psidii*** Maskell 1892

Trans. N. Z. Inst. 25 : 223 ; Takahashi 1928 Philip. J. Sci. 36 : 334 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 6 ; Steinweden 1946 Microentomology 11 : 11, 26, fig. 11.

Syn. : *Pulvinaria cupaniae* Cockerell 1893, *P. ficus* Hempel 1900.

Hosts : *Artocarpus integrifolia*, *Chrysophyllum cainito*, *Citrus* spp., *Coffea arabica*, *Euphoria longana*, *Gardenia florida*, *Mangifera indica*, *Psidium guyava*, *Psychotria elliptica*.

Locality record : Taipei, Peitau, Chiayi.

***P. taiwana*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 61.

Host : *Mangifera indica*.

Locality record : Chiayi.

Genus ***Saissetia*** Deplanche 1859

Soc. Linn. de Normandie Bull. 4 : 203—207. Type : *Saissetia coffeae* Deplanche 1859=*Lecanium coffeae* Walker 1852.

***S. armata*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 33.

Hosts : *Glochidion dasyphyllum*, *Eugenia jambos*.

Locality record : Kenting.

***S. bobuae*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 8.

Host : *Bobua* (*Symplocos*) *arisanensis*.

Locality record : Suo, Alishan.

***S. formicarii*** (Green 1896)

Ind. Mus. Not 4 : 1, *Lecanium* ; Takahashi 1928 Philip. J. Sci. 36 : 343, *Saissetia* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 58.

Hosts : *Aegle sepiaria*, *Aglia odorata*, *Ardisia sieboldii*, *Areca oleracea*, *Artocarpus integrifolia*, *Bischoffia javanica*, *Callicarpa formosana*, *Camellia chinensis*, *C. japonica*, *Cinnomomum camphor*, *C. c. nominale*, *C. zeylanicum*, *Disopyros raki*, *D. discolor*, *Eucalyptus* sp., *Eugenia javanica*, *Evodia triphylla*, *Ficus leucantatoma*, *F. vasculosa*, *F. wightiana*, *F.* sp., *Garcinia spicata*, *Gardenia florida*, *Gordonia axillaris*, *Grevillea robusta*, *Kentia macarthurii*, *Lagerstroemia flos-reginae*, *Lithocarpus*, *Machilus* sp., *Mangifera indica*, *Michelia alba*, *M.* sp. *Myristica heterophylla*, *Olea europa*, *Palaqium formosanum*, *Persea gratissima*, *Prunus* sp., *Psidium guyava*, *Rhus verniciflua*, *Salix* sp., *Sapium sebiferum*, *Scheffera octophylla*. *Schima confertiflora*.

Locality record : Taipei, Hsintien, Shihlin, Yuanshan, Shihtin, Hsinchu, Changhua, Yuechih, Shuishe, Puli, Chushan, Chiayi, Kuantzuling, Kenting.

***S. hemisphaerica*** (Targioni-Tozzetti 1867)

Studi sulle Coccinigli : 27, *Lecanium hemispaeticum* ; Shiraki 1913 Agr . Expt. Stat. Formosa Rept. Spec. 8 : 8 5 ; Maki

1915 Forest Expt. Sta. Spec. Rept. 1 : 27 ; Takahashi 1928 Philip. J. Sci. 36 : 342, *Saissetia hemisphaerica* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 59.

Syn. : *Saissetia coffeae* Signoret 1873.

Hosts : *Adiantum* sp., *Anona* sp., *Ardisia crispa*, *A. quinquegona*, *Bischoffia javanica*, *Calanthe* sp., *Camellia chinensis*. *Carrissa carandas*, *Chrysophyllum cainito*, *Cinchona* sp., *Citrus* spp., *Coffea arabica*, *Cunninghamia lanceolata*, *Eugenia uniflora*, *Ficus wightiana*, *Cucurbita moschata*, *Cycas revoluta*, *Diospyros discolor*, *Garcinia spicata*, *Gardenia florida*, *Ixoa chinensis*, *Lagerstroemia indica*, *Machilus* sp., *Mangifera indica*, *Osmanthus fragrans*, *Plumeria acutifolia*, *Psydium guyava*, *Psychotria elliptica*, *Rhus verniciflua*, *R.* sp., *Tabernaemontana* sp.

Locality record : Ilan, Taipei, Tanshui, Hsintien, Wulai, Pingchien, Changhua, Shuishe, Puli, Chushan, Chiayi, Chuchi, Fenchifu, Alishan, Kuantzuling, Hsinhua, Pingtung, Henchun, Kenting, Ouluanpi, Taitung, Chihpen, Lanhsu.

***S. nigra*** (Niether 1861)

Enemies of Coffee Tree ; 9. *Lecanium nigrum* ; Takahashi 1928 Philip. J. Sci. 36 : 342, *Saissetia nigra* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 57.

Hosts : *Ardisia quinquegona*, *Areca catechu*, *Artemisia capillaris*, *Bischoffia javanica*, *Calophyllum inophyllum*, *Canna indica*, *Chrysophllum cainito*, *Citrus* spp., *Codiaeum variegatum*, *Eugenia javanica*, *Ficus elastica*, *F. carica*, *F. gibbosa*, *F. retusa*, *F.* sp., *F. wightiana*, *Gossypium herbaceum*, *Glochidion* sp, *Morus alba*, *Musa sapientum*, *Plumeria aculifolia*, *Psidium guyava*, *Pirus* sp., *Salix warburgii*, *Sapium sebiferum*, *Terminalia catappa*.

Locality record : Taipei, Tanshui, Shihlin, Ilan, Changhua, Yuanlin, Erhshui, Chushan, Tuniu, Puli, Chiayi, Tainan, Kaohsiung, Pingtung, Ouluanpi, Hualien, Taitung, Lanhsu.

***S. oleae*** (Bernard 1782)

Mem. d. Hist. Nat. Acad. : 108, *Chermes* : Takahashi 1928 Philip. J. Sci. 36 : 343, *Saissetia*, 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 58.

Hosts : *Callophyllum inophyllum*, *Euphoria longana*, *Gardenia florida*, *Gossypium herbaceum*, *Nerium odorum*, *Tectona grandis*, *Terminalia catappa*.

Locality record : Taipei, Changhua, Puli, Chiayi, Kenting.

Genus ***Vinsonia*** Signoret 1872

Ann. Soc. Ent. France 5, 2 : 33. Type : *Vinsonia pulchella* Signoret 1872= *Coccus stellifera* Westwood 1871.

***V. stellifera*** (Westwood 1871)

Proc. Ent. Soc. London 3 ; 3, *Coccus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 69.

Hosts : *Garcinia spicata*, *Mangifera indica*.

Locality record : Kenting.

## Family DIASPIDIDAE

### Tribe Leucaspidini

Genus ***Leucaspis*** Targioni-Tozzetti 1868

Soc. Ital. Sci. Nat. Atti. 11 : 41 ; Takagi 1969 Ins. Mats. 32 : 25. Type : *Leucaspis canidia* Targioni-Tozzetti 1868=*Coccus pini* Hartig 1839.

Syn. : *Actanaspis* Leonard 1906. *Anamaspis* Leonard 1906, *Euleucaspis* Lindin-

ger 1905, *Leucodiaspis* Signoret 1869, *Maniaspis* Borchsenius 1969, *Pusillaspis* Lindinger 1940, *Rhopaloaspis* De Guercio 1902, *Salicicola* Lindinger 1905, *Sutruraspis* Lindinger 1906.

***L. incisa*** Takagi 1969

Ins. Mats. 32 : 26.

Host : *Machilus japonica.*

Locality record : Yangmingshan.

***L. machili*** Takagi 1969

Ins. Mats. 32 : 26.

Hosts : *Machilus japonica, M. kusanoi.*

Locality record : Yangmingshan, Chuchi, Kenting.

***L. vitis*** (Takahashi 1935)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 19, *Leucodiaspis.*

Host : *Vitis* sp.

Locality record : Kaohsiung.

Genus ***Lopholeucaspis*** Balachowsky 1953

Actual Sci. Industr. 1202 : 153. Type : *Leucaspis japonica* Cockerell 1897

***L. japonica*** (Cockerell 1897)

Psyche 8 : 53, *Leucaspis* ; Kuwana 1923 Dobuts Zasshi 35 : 321, further description ; Takagi 1969 Ins. Mats. 32 : 31, *Lopholeucaspis* ; Takahashi 1934 Dept. Agr. Gov't. Res, Inst. Formosa Rept. 63 : 15, *Leucodiaspis hydrangeae* ; 1939 Mushi 12 : 89, *Leucaspis hydrangeae* ; Takagi 1970 Ins. Mats. 33 : 137.

Syn. : *Leucaspis japonica* var. *darwiensis* Green 1916, *Leucaspis hydrangeae* Takahashi 1934.

Hosts : *Eurya crenatifolia, Hydrangea integrifolia* (=*integra*) , *H.* sp., *Liquidamaba formosana, Pittosperm tolira, Rhododendrum* spp.,

Locality record : Taipei, Yunlin.

Genus ***Parlatoria*** Targioni 1868

Atti. Soc. Ital. Sci. Nat. 11 : 42 ; Mc Kenzie 1945 Microentomology 10 : 47—121 ; Takagi 1969 Ins. Mats. 32 : 31. Type : *Aspidiotus proteus* Curtis 1843.

Syn. : *Archangelskaia* Bodenheimer 1851, *Euparlatoria* Leonardi 1903, *Websteriella* Leonardi 1899, *Apteronidia* Leonardi 1900.

***P. arengae*** Takagi 1969

Ins. Mats. 32 : 36.

Host : *Arenga engleri.*

Locality record : Taipei, Kenting.

***P. camelliae*** Comstock 1883

2nd Rept. Dept. Ent. Cornell Univ. Agr. Expt. Sta. 2 : 114, *Parlatoria pergandii* var. *camelliae* ; Morrison 1939 U. S. D. A. Mis. Publ. 344 ; 8 ; Takagi 1969 Ins. Mats. 32 : 33.

Hosts : *Callophyllum inophyllum, Ficus cuspidatocaudata, Gordonia axillaris, Machilus kusanoi, Rhododendron ellipticum.*

Locality record : Taipei, Henchun, Kenting.

***P. cinerea*** Hadden 1909

Can. Ent. 41 : 299 ; Takagi 1969 Ins. Mats. 32 : 38.

Syn. : *Parlatoria fluggeae* var. *braziliensis* de Costa Lima 1934, *Parlatoria pseuopyri* Kuwana and Muramatsu 1932

Host : *Citrus* sp.

Locality record : Shihlin, Chuchi.

***P. crotonis*** Douglas 1887

Ent. Mon. Mag. 23 : 242, *Parlatoria proteus* var . *crotonis.*

Syn. : *Parlatoria greeni* Banks 1906.

Hosts : *Acer* sp., *Dendrobium moschatum, Illicium philippinese* (=*randaiense* )

Locality record : Taipei, Shihlin, Yangmingshan.

***P. fluggeae*** Hall 1929

Bull. Ent. Res. 20 : 35 9 ; Takagi 1969 Ins. Mats. 32 : 39.

Host : *Beohmeria densiflora.*

Locality record : Kuantzuling.

***P. lithocarpi*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 29, fig.

Host : *Lithecarpus* sp.

Locality record : Kaohsiung, Pingtung.

***P. machili*** Takahashi 1931

Bull. Ent. Res. 22 : 218 ; McKenzie 1945 Microentomology 10 : 66 ; Takagi 1969 Ins. Mats. 32 : 37.

Host : *Machilus japonica.*

Locality record : Yangmingshan, Chuchi.

***P. machilicola*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 52, figs.

Hosts : *Machilus kusanoi, Machilus* sp.

Locality record : Tungshih, Fenchifu, Kenting, Henchun.

***P. mytilaspiformis*** Green 1899

Coccidae Ceylon 2 : 104, pl. 58.

Host : *Camellia* sp.

Locality record : Yuechih.

***P. pergandei*** Comstock 1881

Rept. U. S. D. A. for 1880 : 327 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 77.

Syn. : *Parlatoria sinensis* Maskell 1897.

Hosts : *Camellia japonica, Citrus* spp., *Cymbidium sinensis, Eurya* sp., *Ficus foveolata, F. retusa, Osmanthus fragrans, Pandanus tectorius, Scolopia oldhami.*

Locality record : Taipei, Peitau, Taichung.

***P. proteus*** (Curtis 1843)

Gard. Chron : 676, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 78 ; Takagi 1969 Ins. Mats. 32 : 34.

Syn. : *Aspidiotus targionii* de Guercio 1894, *Diaspis parlatoris* Targioni-Tozzetti 1867, *Parlatoria orbicularis* Targioni-Tozzetti 1868.

Hosts : *Chrysalidocarpus lutescens, Citrus* spp., *Cymbidium sinensis, Monstera deliciosa, Mangifera indica, Osmanthus* sp., *Phalaenopsis amabilis, Vitis* sp.

Locality record : Taipei, Henchen.

***P. virescens*** Maskell 1897

Trans. N. Z. Inst. 29 : 300, *Parlatoria proteus* var. *virescens.*

Host : A liliaceous plant.

Locality record : Taiwan.

***P. zizyphi*** Lucas 1853

Bull. Soc. Ent. France 3 : 28 ; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 97 ; Maki 1915 Forest Expt. St. Formosa Spce. Rept. 1 : 26 ; Takahashi 1929 Dep. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 77 ; McKenzie 1945 Microentomology 10 : 76, fig. 53 ; Takagi 1969 Ins. Mats. 32 : 36.

Host : *Citrus* spp.

Locality record : Taipei, Shihlin, Wulai, Ilan, Chushan, Chiayi, Matou, Pingtung, Chaochow.

Genus ***Parlatoreopsis*** Lindinger 1912

Die Schildlause 14 : 191 ; Takagi 1969 Ins. Mats. 32 : 40. Type : *Chionaspis longispina* Newstead 1911.

Syn. : *Anatolaspis* Bodenheimer 1951.

***P. chinensis*** (Marlatt 1908)

Wash. Tech. Ser. U. S. D. A. Ent. 16 : 30, *Parlatoria* ; Takagi 1969 Ins. Mats.

32 : 41, *Parlatoreopsis*.

Host : *Hibiscus tiliacens*

Locality record : Henchun.

Genus ***Neoparlatoria*** Takahashi 1931

J. Soc. Trop. Agr. Formosa 3 : 381 ; Takagi 1969 Ins. Mats. 32 : 43. Type : *Neoparlatoria formosana* Takahashi 1931

*N.* ***formosana*** Takahashi 1931

J. Soc. Trop. Agr. Formosa 3 : 382, fig.

Hosts : *Lithocarpus* spp., *Cyclobalanopsis glauca*.

Locality record : Taipei, Shihlin, Wulai, Kaohsiung, Taitung.

*N.* ***lithocarpi*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 28, fig, 1935 Dept. Agr. Gov'. Res. Inst. Formosa Rept. 66 : 31.

Host : *Lithocarpus uraiana* (*Passania uraiana*) .

Locality record : Hsintien, Yangmingshan.

*N.* ***lithocarpicola*** Takahashi 1931

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 30, figs.

Hosts : *Castanopsis* sp., *Lithocarpus uraiana*.

Locality record : Hsintien, Shuishe, Wulai, Tungshih.

*N.* ***maai*** Takagi 1969

Ins. Mats. 32 : 44.

Host : *Castanopsis* sp.

Locality record : Alishan.

*N.* ***miyamotoi*** Takagi 1969

Ins. Mats. 32 : 44.

Host : *Castanopsis kusanoi*.

Locality record : Fenchifu.

Genus ***Mixaspis*** Takahashi 1932

J. Soc. Trop. Agr. Formosa 4 : 26 ; Ferris 1937 Microentomology 2 : 104, 113 ; fig. 86 ; Takagi 1969 Ins. Mats. 32 : 48. Type : *Leucaspis bambusicola* Takahashi 1930.

***M. bambusicola*** (Takahashi 1930)

Dept. Agr. Gov't, Res. Inst. Formosa Rept. 48 : 26, *Leucaspis* ; 1932 J. Soc. Trop. Agr. Formosa 4 : 46, *Mixaspis* ; Takagi 1969 Ins. Mats. 32 : 50.

Host : Bamboo.

Locality record : Yangmingshan, Erhshui.

Genus ***Silvestraspis*** Bellio 1929

Bull. Lab. Zool. Portici 22 : 159. Type : *Silvestraspis sinensis* Bellio 1929.

*S.* ***uberifera*** (Lindinger 1911)

Zeits f. Wiss. Insektenbiol 7 : 89 and 126, *Cryptoparlatorea* ; Takahashi 1947 Dept. Agr. Gov't. Res. Ins. Formosa Rept. 81 : 46, *Silvestraspis sinensis* ; Takagi 1969 Ins. mats, 32 : 47.

Syn. : *Silvestraspis sinensis* Bellio 1929.

Hosts : *Cinnamomum zeylanicum*, *Machilus kusanoi*.

Locality record : Kenting.

## Tribe Rugaspidiotini

Genus ***Poliaspoides*** MacGillivray 1921

Coccidae : 309 ; Ferris 1937 Microentomology 3 : 17, 42, fig. 21 ; Takagi 1969 Ins. Mats. 32 : 58. Type : *Chionaspis simplex* Green 1905.

Syn. : *Natalaspis* MacGillivray 1921.

***P. formosana*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 49 : 29, *Odonaspis simplex* Green var. *formosana* ; Takagi 1969 Ins, Mats. 32 : 58, *Poliaspoides*.

Syn. : *Chionaspis simplex* Green var. *mauritiensis* de Charm (vide Mamet 1946 Maurtitius Inst. Bull. 2 : 244)

Host : Bamboo.
Locality record : Yangmingshan.

Genus ***Smilacicola*** Takagi 1969

Ins. Mats. 32 : 55. Type : *Smilacicola apicalis* Takagi 1969

***S. apicalis*** Takagi 1969
Ins. Mats. 32 : 55.
Host : *Smilax* sp.
Locality record : Kenting.

## Tribe Odonaspidini

Genus ***Odonaspis*** Leonardi 1893

Rio par. Veg. 5 : 284 ; Takagi 1969 Ins. Mats. 32 : 60. Type : *Aspidiotus secretus* Cockerell 1896

Syn. : *Anoplaspis* Leonardi 1900, *Bakeraspis* Mac Gillivray 1921, *Berlesaspidiotus* Mac Gillivray 1921, *Dycryptaspis* Leonardi 1897, *Froggatiella* Leonardi 1900, *Spatheaspis* Leonardi 1898.

***O. pencillata*** Green 1905
J. Bomb. Nat. Hist. Soc. 16 : 346 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 78 ; Takagi 1969 Ins. Mats. 32 : 62.
Syn. : *Aspidiotus inusitatus* Green 1896, *Forggatiella inusitata* Leonardi 1900
Hosts : *Bambusa stenostachya*, *Dendrocalamus latiflorus*.
Locality record : Taipei, Yuanshan, Yangmingshan, Henchun.

***O. secreta*** (Cockerell 1890)
Psyche 7, suppl. 1 : 2, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 78.
Syn. : *Odonaspis secreta* Green var. *greeni* Cockerell 1902.
Host : *Bambusa stenostachya*.
Locality record : Taipei.

## Tribe Aspidiotini

Genus ***Aspidiotus*** Bouche 1833

Nat. Sch. und Nutzl. Gart. Ins. 52 ; Ferris 1937 Microentomology 2 : 62, fig. 41 ; Takagi 1969 Ins. Mats. 32 : 62. Type : *Aspidiotus nerii* Bouche=*A.* (*Dynaspidiotus*) *hederae* (Vallot) .

Syn. : *Cryptoaonidia* Leonardi 1899, *Cryptophyllaspis* Cockerell 1897, *Dynaspidiotus* Theim and Gerneck 1934, *Evaspidiotus* Leonardi 1898, *Phaulaspis* Leoarndi 1897, *Varicaspis* MacGillivray 1921.

***A. cryptomeriae*** Kuwana 1902
Pap. Calif. Ac. 3 : 69 ; Ferris 1953 Microentomology 18 : 65, fig. 36 ; Takagi 1969 Ins. Mats. 32 : 64.
Host : *Cryptomeria japonica*.
Locality record : Yangmingshan, Fenchifu.

***A. destructor*** Signoret 1869
Ann. Soc. Ent. France (Ser. 4) 9 : 120 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 79 ; Ferris 1941 Microentomology 6 : 51 ; Takagi 1969 Ins. Mats. 32 : 65.
Syn.: *Aspidiotus beilschmiediae* Takagi 1969, *A. cocotis* Newstead 1893, *A. fallax* Cockerell 1893, *A. transparens* Green 1890, *A. oppugnatus* Sivlestri 1914, *A. simillimus* var. *tranlucens* Cockerell 1903, *A. vastrix* Leroy 1896, *A. watanabei* Takagi 1969.

Hosts : *Anona squamosa*, *Achras zapota*, *Beilschmiedia erythrophloia*, *Camellia japonica*, *C. sinensis*, *Carica papaya*, *Cinnamomum* sp., *Citrus* spp., *Chrysalidocarpus lutescens*, *Cocos nucifera*, *Cycas revoluta*, *Cymbidium gyokuchin*, *Diospyros discolor*, *Ficus beecheyana*, *F.* sp., *Hibiscus roasesinensis*, *Ligustrum japonicum*, *Lonicera japonica*. var. *sempervil-*

*losa, Maesa japonica, Mangifera indica, Michelia champaca, Morus* sp., *Pandanus boninensis, P. tectorius, Psidium guajava, Psychotria rubra, Sapium sebiferum, Saccharrium offiainarum, Musa* sp., *Trachycarpus fortunei, Viburnum arboricolum.*

Locality record : Taipei, Taichung, Chiayi, Kuantzuling, Yunlin, Fenchifu, Kaohsiung, Pingtung, Penghu.

***A. excisus*** Green 1896

Coccidae Ceylon : 53, pl. 10, figs. 7—9 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 79 ; Ferris 1941 Microentomology 6 : 53, fig 20 : Takagi 1969 Ins. Mats. 32 : 701.

Syn. : *Aspidiotus hoyae* Takagi 1969

Hosts : *Clerodendrun inerme, Elephantopus mollis, Glochidion konkongense, Hoya carnosa, Rhodendron* sp., *Rhus semialata, Urenlobata* sp., *Viburnum* sp.

Loclaity record : Hsintien, Peitau.

***A. pothos*** Takagi 1969

Ins. Mats. 32 : 79.

Host : *Pothos seemanii.*

Locality record : Taipei.

Genus ***Taiwanaspidiotus*** Takagi 1969

Ins. Mats. 32 : 72. Type : *Aspidiotus shakunagi* Takahashi 1935.

***T. shakunagi*** (Takahashi 1935)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 32, *Aspidiotus.*

Host : *Rhododendron* sp.

Locality record : Chihpen, Alishan.

***T. yiei*** Takagi 1969

Ins. Mats. 32 : 75.

Host : *Quercus* sp.

Locality record : Fenchifu.

Genus ***Hemiberlesia*** Cockerell 1891

Riv. Pat. Veget. 6 : 105, 107 ; Takagi 1969 Ins. Mats. 32 : 76. Type : *Aspidiotus rapax* Comstock 1881.

Syn. : *Aspidites* Berlese and Leonardi 1896, *Diaspidiotus* Berlese 1896, *Chemnaspis* MacGillivary 1921, *Forbesaspis* Mac Gillivray 1921, *Marlattaspis* MacGillivray 1921, *Quadraspidiotus* MacGillivray 1921, *Euraspidiotus* Thiem and Gerneck 1934, *Abgrallaspis* Balachowsky 1934, *Hemiberlesiana* Theim and Gerneck 1934, *Ephedraspis* Borchsenius 1949.

***H. chipposanensis*** (Takahashi 1935)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 33, *Aspidiotus.*

Host : *Rhododendron* sp.

Locality record : Chihpen.

***H. cyanophylli*** (Signoret 1869)

Ann. Soc. Ent. France 9 (4) : 119, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 79 ; Takagi 1969 Ins. Mats. 32 : 78, *Hemiberlesia.*

Hosts : *Camellia japonia, C. sinensis, Celtis sinensis, Cocos nucifera, Gardenia.* sp., *Maesa* sp., *Mangifera indica, Psychotria serpens.*

Locality record : Shuishe, Chiayi, Kuantzuling.

***H. lataniae*** (Signoret 1869)

Ann. Soc. Ent. France 9 (4) : 124, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 80 ; Takagi 1969 Ins. Mats. 32 : 78, *Hemiberlesia.*

Syn. : *Aspidiotus cydoniae* Comstock 1881, *A. c.* var. *tecta* Maskell 1897, *Aspidiotus punicae* Cockerell 1893, *Aspidiotus diffinis* var. *laterallis* Cockerell 1894, *A.* (*Hemiberlesia*) *crawii* Cockerell 1897, *A.* (*Diaspidiotus*) *greeni* Cockerell1897, *Aspidiotus implicatus* Maskell 1896.

Hosts : *Ardisia sieboldi*, *Cocos nucifera*, *Cycas revolata*, *Cymbidium sinese*, *Diospyros discolor*, *Garcinia spicata*, *Hibiscus rosa-sinensis*, *Juniperus* sp., *Listsea akoensis*, *Rhododendron* sp., *Ravaenala madagscariensis*, *Mangifera indica*, *Melastoma candidum*, *Morus* sp., *Psidium guajava*, *Saurania tristyla* var. *oldhamii*.

Locality record : Yuanshan, Yangmingshan, Kuantzuling, Kaohsiung, Henchun, Kenting, , Hualien.

***H. pitysophila*** Takagi 1969

Ins. Mats. 32 : 79.

Host : *Pinus* sp.

Locality record : Yangmingshan.

***H. rapax*** (Comstock 1881)

Rept. U. S. D. A. for 1880 : 307, *Aspidiotus* ; Takagi 1969 Ins. Mats. 32 : 77, *Hemiberlesia*.

Syn. : *Aspidiotus camelliae* Boisduval 1869, *Aspidiotus lucumae* Cockerell 1899.

Hosts : *Actinidia arisanensis*, *Ilex* sp.,

Locality record : Fenchifu.

Genus ***Aonidiella*** Berlese and Leonardi 1895

Riv. Pat. Veget 4 : 77 ; McKenzie 1938 Microentomology 3 : 1—36 ; Takagi 1969 Ins. Mats. 32 : 81. Type : *Aspidiotus aurantii* Maskell 1879.

Syn. : *Heteraspis* Leonardi 1914.

***A. aurantii*** (Maskell 1878)

Trans. N. Z. Inst. 11 : 199, *Aspidiotus*; Ferris 1921 Bull. Ent. Res. 12 : 219, *Chrysomphalus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 80, *Chrysomphalus* ; Takagi 1969 Ins. Mats. 32 : 82, *Aonidiella*.

Syn. : *Aspidiotus citri* Comstock 1881, *A. coccineus* Gennadius 1881, *Aonidiella gennadii* Targioni 1881.

Hosts : *Ardisia japonica*, *Citrus* spp., *Heptapleurum octophyllum*, *Maesa tenera*.

Locality record : Taipei, Chiayi. Chuchi, Matou, Fengshan.

***A. citrina*** (Coquillett 1891)

U. S. D. A. Div. Ent. Bull. 23 : 29, *Aspidiotus* ; Takagi 1969 Ins. Mats. 32 : 82.

Hosts : *Ardisia sieboldii*, *Citrus* spp., *Cleyera japonica* var. *morii*, *Livistona subglosa*, *Helicia formosana*, *Maesa tenera*, *Smilax* sp.

Locality record : Taipei, Yangmingshan, Kuantzuling, Fenchifu.

***A. comperei*** McKenzie 1937

Univ. Calif. Publ. Ent. 6 : 327 ; Takagi 1970 Ins. Mats. 33 : 131.

Host : *Musa sapientum*.

Locality record : Taiwan.

***A. inornata*** McKenzie 1938

Microentomology 3 : 10 ; Takahashi 1939 Mushi 12 : 88.

Syn. : *Chrysomphalus aurantii* Robinson nec Maskell 1917.

Hosts : *Carica papaya*, *Cycas* sp.

Locality record : Kuantzuling, Fengshan, Henchun.

***A. messengeri*** McKenzie 1953

Bull. Calif. Dept. Agr. 42 : 35, fig.

Host : *Bladhia sieboldii*.

Locality record : Taiwan.

***A. taxus*** Leonardi 1906

Redia 3 : 1 ; McKenzie 1938 Microentomology 3 : 15.

Host : *Podocarpus macrophylla*.

Locality record : Taiwan.

***A. tsugae*** Takagi 1969

Ins. Mats. 32 : 84.

Host : *Tsuga chinensis* var. *formosana*.

Locality record : Tungpu.

Genus ***Chrysomphalus*** Ashmead 1880

Amer. Ent. 3 : 268 ; Ferris 1937 Microentomology 2 : 64, fig. 43 ; 105, 121, fig. 94 ; 1938 Atlas Scale Insects N. Amer. SII-198 ; McKenzie 1939 Microentomology 4 : 51 ; Takagi 1969 Ins. Mats. 32 : 85. Type : *Chrysomophalus ficus* Ashmead=*Coccus aonidum* Linnaeus 1758.

***C. bifasciculatus*** Ferris 1938

Atlas Scale Insects N. Amer SII—199 ; Takagi 1969 Ins. Mats. 32 : 87.

Hosts : *Cycas* sp., *Dianellia ensifolia.*

Locality record : Taipei, Henchun.

***C. dictyospermi*** (Morgan 1889)

Ent. Mon. Mag. 25 : 352, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 82, *Chrysomphalus* ; Lindinger 1949 Entomology : 211, *dictyospermatis.*

Syn. : *Aspidiotus dictyospermi* var. *arecae* Newstead 1893, *Aspidiotus mangiferae* Cockerell 1893 ; *Aspidiotus dictyospermi* var. *jamaicensis* Cockerell 1893, *Chrysomphalus minor* Berese and Leonardi 1896, *Aspidiotus agrumincola* Gregaris 1915, *Chrysomphalus castigatus* Mamet 1936.

Hosts : *Citrus* spp., *Cycas revoluta.*

Locality record : Taipei, Pingtung.

***C. ficus*** Ashmead 1880

Amer. Ent. 3 : 268 ; Ferris 1921 Bull. Ent. Res. 10 : 220, *aonidum* L ; Shiraki 1921 Agr. Expt. Stat. Spec. Rept. 8 : 93, *Aspidiotus ficus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 81, *aonidum* L., Takagi 1969 Ins. Mats. 32 : 86, *Chrysomphalus ficus.*

Syn. : *Chrysomphalus aonidum* Linnaeus 1758.

Hosts : *Areca catecha, Artabotrys uncinatus, Buxus japonicus, Calophyllum inophyllum, Camellia chinensiss, C. japonica, Carina carandas, Cinnamomum camphor, Citrus* spp., *Cleryera japonica* var. *japonica, Cocos nucifera, Cycas revoluta, Evodia roxburzhiana, Ficus retusa, Garcinia spicata, Ligustrum japonicum, Machilus* sp., *Mahonia japonica, Musa sapientum, Myristica heterophylla, Osmanthus fragrans, Palaquium formosanum, Pandanus tectorius, Pinus* sp., *Podocarpus macrophyllus, Rosa* sp. *Thevetia* sp.

Locality record : Taipei, Shihlin, Hsintien, Chushan, Puli, Ehrshui, Chiayi, Hsinhua, Tainan, Pingtung, Henchun, Taitung, Ilan, Lotung, Yensuikong.

Genus ***Lindingaspis*** MacGillivray 1921

Coccidae : 388 and 422 ; McKenzie 1950 Microentomology 15 : 98 ; Takagi 1969 Ins. Mats. 32 : 87. Type : *Lindingaspis samoana* Lindinger 1911.

***L. ferrisi*** McKenzie 1950.

Microentomology 15 : 100 ; Takagi 1969 Ins. Mats. 32 : 88.

Hosts : *Callophyllum inophyllum, Citrus* sp.

Locality record : Henchun.

***L. rossi*** (Maskell 1890)

Trans. N. Z. Inst. 23 : 3, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 81, *Chrysomphalus* ; Ferris 1938 Atlas Scale Insects N. Amer. SII—241, *Lindingaspis* ; McKenzie 1950 Microentomology 15 : 104, 119, fig. 57.

Hosts : *Bryophyllum calycinum, Calophyllum inophyllum, Kandelia rheedii* ( *=candel*) , *Mangifera indica, Cocos nucifera, Diospyros eriomtha, Ficus pumila, Pyracantha koidzumi, Scolopia oldhamii, Vitis* sp.

Locality record : Taipei, Changhua,

Yuechih.

Genus ***Crassaspidiotus*** Takagi 1965

Ins. Mats. 32 : 89. Type : *Crassapidiotus takahashii* Takagi 1969.

***C. takahashii*** Takagi 1969

Ins. Mats. 32 : 89.

Host : *Tsuga chinensis* var. *formosana*.

Locality record : Tungpu.

Genus ***Metaspidiotus*** Takagi 1957

Ins. Mats. 21 : 35 ; 1969 Ins. Mats. 32 : 91. Type : *Aspidiotus stauntoniae* Takahashi 1938.

***M. machili*** (Takahashi 1931)

J. Soc. Trop. Agr. Formosa 3 : 384, *Aspidiotus* ; Takagi 1969 Ins. Mats. 32 : 92, *Metaspidiotus*.

Hosts : *Machilus* sp., *Scheffera octophylla*.

Locality record : Yangmingshan.

***M. stauntoniae*** (Takahashi 1933)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 54, *Aspidiotus* ; Takagi 1957 Ins. Mats. 21 : 36 , *Metaspidiotus* ; 1969 Ins. Mats. 32 : 91.

Hosts : *Eurya* sp., *Ficus foveolata*, *F.* sp., *Hibiscus tiliacens*, *Maesa* sp., *Scolopia oldhamii*, *Stauntonia hexaphylla*, *Vitis* sp.

Locality record : Hsintien, Henchun.

Genus ***Selanomphalus*** Mamet 1958

Ann. Mus. Congo Belge (N. S, ) Sci. Zool. 4 : 426. Type : *Aspidiotus euryae* Takahashi 1931.

***S. euryae*** (Takahashi 1931)

J. Soc. Trop. Agr. Formosa 3 : 383, *Aspidiotus* ; Takagi 1969 Ins. Mats. 32 : 95, *Selanomphalus*.

Hosts : *Camellia sinensis*, *Eurya* sp., *Gordonia axillaris*, *Loranthus parasiticus*.

Locality record : Taipingshan, Shuishe, Yushan, Yangmingshan.

Genus ***Diaonidia*** Takahashi 1956

Ins. Mats. 20 : 25. Type : *Aonidia yabunikkei* Kuwana 1933.

***D. cinnamomi*** (Takahashi 1930)

Trans. N. H. Soc. Formosa 26 : 82, *Gymnaspis* ; Takagi 1969 Ins. Mats. 32 : 96.

Host : *Machilus* sp.

Locality record : Kenting.

Genus ***Pseudanonidia*** Cockerell 1897

Tech. Ser. U. S. D. A. Ent. 6 : 14 ; Ferris 1938 Atlas Scale Insects N. Amer. SII—252 ; 1937 Microentomology II : 55, 91, fig. 70. Type : *Aspidiotus duplex* Cockerell 1896.

Syn. : *Pseudaonidiella* MacGillivray 1921.

***P. duplex*** (Cockerell 1896)

Psyche 7, suppl. 1 : 20, *Aspidiotus* ; Ferris 1921 Bull. Ent. Res. 12 : 220 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 79, *Pseudaonidia*.

Syn. : *Aspidiotus theae* Maskell nec Green 1890, *A. theae* var. *rhododendri* Green 1900, *Pseudaonidia rhododendri thearum* Cockerell 1903.

Host : *Michelia fuscata*.

Locality record : Taipei.

***P. trilobitiformis*** (Green 1896)

Ind. Mus. Notes 4 : 4, *Aspidiotus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 78, *Pseudaonidia*; Takagi 1969 Ins. Mats. 32 : 98.

Syn. : *Aspidiotus darutyi* de Charmoy 1898.

Hosts : *Artocarpus integrifolia*, *Calophyllum inophyllum*, *Camellia japonica*, *Citrus* spp., *Cudrana cochinchinensis*,

*Diospyros eriantha*, *Eurya japonica*, *Ficus elastica*, *F. pumila*, *F. retusa*, *F. swinhoei*, *Machilus* sp., *Murraya exotica*, *Quercus* sp., *Scolopia oldhamii*, *Trachdospermum foetidum*.

Locality record : Taipei, Yangmingshan, Keelung, Ilan, Chiayi, Chuchi, Kenting, Ouluanpi, Penghu.

Genus ***Aspidiella*** Leonardi 1898

Rev. Pat. Veget. 210 : 220 ; Ferris 1946 Microentomology 11 : 61, fig. 40 ; Ferris 1938 Atlas Scale Insect N. Amer. SII—187. Type : *Aspidiotus sacchari* Cockerell 1893.

Syn. : *Monaonidella* MacGillivray 1921

***A. phragmitis*** (Takahashi 1931)

Trans. N. H. Soc. Formosa 21 : 4, *Aspidiotus* ; 1933 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 54 ; Takagi 1958 Inst. Mats. 21 : 122, *Aspidiella*.

Syn. : *Aspidiotus miscanthi* Kuwana 1931.

Hosts : *Phragmitis* sp., *Thysanolaea maxima*.

Locality record : Taipei, Suo.

Genus ***Clavaspidiotus*** Takagi and Kawai 1966

Ins. Mats. 28 : 115. Type : *Clavaspidiotus abietis* Takagi and Kawai 1966.

***C. tabayanus*** (Cockerell 1905)

Proc. Davenport Acad. Sc. Iowa 10 : 133, *Aspidiotus* ; Takahashi 1933 Dept. Agr. Gov't. Res. Inst. Formosa, Rept. 60 : 56, *Chrysomphalus* ; Takagi and Kawai 1966 Ins. Mats. 28 : 115 *Clavaspidiotus*.

Host : *Pyracantha koidzumi*.

Locality record : Taitung.

Genus ***Melanaspis*** Cockerell 1897

Leonardi : Riv. di Patol Veg. 5 : 375 ; Ferris 1941 Atlas Scale Ins. N. Amer. SII —328, SIII—347.

Syn. : *Crenulaspidotus* MacGillivray 1921, *Greenoidea* MacGillivray 1921, *Pelomphala* MacGillivray 1921.

***M. smilacis*** (Comstock 1883)

2nd Rep. Dept. of Ent. Corn. Univ. : 69, *Aspidiotus smilacis* ; Ferris 1941 Atlas Scale Ins. N. Amer. SIII—366.

Syn. : *Aonidiella bromeliae* Leonardi 1899, *Aspidiotus* (*Aonidiella*) *multiclavata* Green and Laing 1923, *Pseudischnaspis anassarum* Lindinger 1923, *Aspidiotus* (*Targionia*) *marlatti* Parrot 1899.

Host : *Ananas comosus*.

Locality record : Taiwan

Genus ***Aonidia*** Targioni-Tozzetti 1868

Soc. Ital. Sci. Atti. 11 : 42. Type : *Aonidia purpurea* Targioni-Tozzetti 1868.

***A. rarasana*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 31, fig.

Host : unknown.

Locality record : Wulai.

***A. tentaculata*** Green var. ***formosana*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 35, fig.

Host : *Cinnamomum* sp.

Locality record : Wushe.

Genus ***Decoraspis*** Ferris 1955

Microentomology 20 : 31. Type : *Decoraspis fimbrata* Ferris 1955=*Aonidia cornigera* Green 1896.

Syn. : *Greeniella* Cockerell 1897

***D. lahoarei*** (Takahashi 1931)

Bull. Ent. Res. 22 : 219, fig. 9, *Aonidia* ; 1935 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 33, fig. var. *formosana*.

Host : *Eugenia* sp.

Locality record : Yangminshan, Shuishe.

Genus ***Pygalataspis*** Ferris 1921

Bull. Ent. Res. 12 : 218 ; 1955 Microentomology 20 : 30 ; Takagi 1969 Ins. Mats. 32 : 108. Type : *Pygalataspis miscanthi*

Ferris 1921.

***P. miscanthi*** Ferris 1921

Bull. Ent. Res. 12 : 218 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 74 ; Takagi 1969 Ins. Mats. 32 : 110.

Host : *Miscanthis sinensis.*

Locality record : Kuantzuling.

Genus ***Thysanaspis*** Ferris 1955

Microentomology 20 : 30 Type : *Thysanaspis acalyptus* Ferris 1955.

***T. perkinsi*** Takagi 1969.

Ins. Mats. 32 : 108.

Host : *Litsea akoensis.*

Locality record : Kuantzuling.

Genus ***Chortinaspis*** Ferris 1938

Atlas Scale Insects N. Amer. SII—194 ; 1955 Microentomology 11 : 37. Type : *Aspidiotus chortinus* Ferris 1921.

***C. bilobis*** (Maskell 1898)

Trans. N. Z. Inst. 30 : 225, *Aspidiotus* ; Ferris 1936 Microentomology 1 : 9 ; 1955 Microentomology 11 : 38, fig. 16, *Chortinaspis.*

Host : Grass.

Locality record : Taiwan.

Genus ***Lepidosaphes*** Shimer 1968

Trans. Amer. Ent. Soc. 1 : 372—373 ; Takagi 1970 Ins. Mats. 33 : 1. Type : *Coccus conchiformis* Gmelin 1789=*Coccus ulmi* Linnaeus 1758.

Syn. : *Mytilaspis* Signoret 1868, *Mytilococcus* Amerling. 1858, *Cepalaspis* Mac Gillivray 1921 , *Cornuaspis* Mac Gillivray 1921.

***L. beckii*** (Newman 1869)

Ent. 4 : 217, *Coccus* ; Shiraki 1913 Agr. Expt. Sta. Formcsa Spec. Rept. 8 : 100, *Lepidosaphes citricola* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 ; 75 *Lepidosaphes* ; Takagi 1970 Ins. Mats. 33 : 8.

Syn, : *Lepidosaphes citricola* Shiraki 1913.

Hosts : *Citrus* spp., *Codiaeum variegatum, Murraya exotica.*

Locality record : Taipei, Keelung, Taitung, Pingtung, Hsinhua.

***L. chinensis*** Chamblin 1925.

Pan-Pacific Ent. 2 : 85, figs.

Host : unknown.

Locality record : Erhshui.

***L. cycadicola*** Kuwana 1931

Dobuts Zasshi 43 : 658, figs. ; Takahashi 1940 Mushi 13 : 26 ; Takagi 1970 Ins. Mats. 33 : 9.

Host : *Cycas revoluta.*

Locality record : Tainan, Pingtung, Henchun, Kenting.

***L. garanbiensis*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 47, fig.

Host : unknown.

Locality record : Ouluanpi.

***L. glancae*** Takahashi 1932

J. Soc. Trop Agr. Formosa 4 : 47.

Host : *Cyclobalanopsis glauca.*

Locality record : Shihlin, Wulai.

***L. gloveri*** (Packard 1869)

Guide to study insects 1 : 527, *Coccus* ; Shiraki 1913 Agr. Expt. Stat. Formosa Spec. Rept. 8 : 99, *Lepidosaphes* ; Takahashi 1929 Dept. Agr.Gov't. Res. Inst. Formosa Rept. 40 : 75 ; Takagi 1970 Ins. Mats. 33 : 7.

Hosts : *Carissa carandas, Citrus* spp.

Locality record : Yangmingshan, Chiayi.

***L. japonica*** (Kuwana 1902)

Prcc. Calif. Acad. Sci. 3, 3 : 89, *Mytilaspis pomerum* var. *japonica* ; Takagi 1970 Ins. Mats. 33 : 3, *Lepidosaphes japonica.*

Host : *Tsuga chinensis* var. *formosa-*

*na.*

Locality record : Tungpu.

***L. leei*** Takagi 1970

Ins. Mats. 33 : 18.

Hosts : *Ilex formosana, Symplocos stellaris, Viburnum arboricolum.*

Locality record: Taipei, Fenchifu, Alishan.

***L. lithocarpi*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 18, figs.

Host : *Lithocarpus* sp.

Locality record : Puli, Shuishe, Taipingshan, Lotung.

***L. maskelli*** (Cockerell 1897)

Trans. N. Z. Inst. 27 : 46, *Mytilaspis pallida* var. *maskelli.*

Hosts : *Juniperus, Podocarpus.*

Locality record: Taipei, Chiaochi, Kaohsiung.

***L. pallida*** (Green 1896)

Ind, Mus. Nots 4 : 5, *Mytilaspis gloveri* Packard var. *pallida* Green ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 75, *Lepidosaphes pallida.*

Host : *Kandelia rheedii.*

Locality record : Shuishe, Chiayi, Ouluanpi, Taitung.

***L. nivalis*** Takagi 1970

Ins. Mats. 33 : 4.

Hosts : *Abies kawakami, Tsuga chinensis* var. *formosana.*

Locality record : Tungpu, Alishan.

***L. pitysophila*** Takagi 1970

Ins. Mats. 33 : 16.

Host : *Pinus* sp.

Locality record : Chiaochi.

***L. takaoensis*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 23, fig.

Hosts : *Celtis sinensis, Codiaeum variegatum.*

Locality record : Kaohsiung.

***L. tokionis*** (Kuwnana 1902)

Pap. Calif. Ac. Sci. 3, 3 : 81, *Mytilaspis newsteadi* var. *tokyonis* ; Ferris 1942 Atl. Scale Ins. N. Amer. SIV 389 ; Takagi 1970, Ins. Mat. 33 : 6.

Syn. : *Mytilaspis auriculata* Green 1907, *Lepidosaphes lasianthi* (Green 1900 )

Host : *Codiaeum variegatum*

Locality record : Kenting.

***L. tubulorum*** Ferris 1921

Bull. Ent. Res. 12 : 16 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 75, Ferris 1953 Microentomology 18 : 61, fig. 26.

Hosts : *Erythrina* sp., *Melia azedarach, Salix glandulosa* var. *warburaii, Sapium sebiferum.*

Locality record : Taipei, Peitau, Hwalien, Taichung, Chiayi.

***L. yamahoi*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 26, fig. *Lepidosaphes cycadicola* var. *yamahoi.*

Host : unknown.

Locality record : Pingtung.

***L. yoshimotoi*** Takagi 1970

Ins. Mats. 33 : 11.

Host : *Chamaecyparis formosensis.*

Locality record : Alishan.

Genus ***Acanthomytilus*** Borchsenius 1947

C. R. Acad. Sci. URSS (N. S. ) 58 : 344 ; Takagi 1970 Ins. Mats. 33 : 24. Type: *Lepidosaphes intermittens* Hall 1921.

***A. chui*** Takagi 1970

Ins. Mats. 33 : 25.

Host : *Miscanthus* sp.

Locality record : Peitau, Kenting.

***A. graminicola*** (Takahashi 1934)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 9, figs. *Chionaspis*

Host : A species of Graminae

Locality record : Hsintien.

*A.* ***imperatae*** (Kuwana 1931)

Dobuts. Zasshi 43 : 170, *Lepidosaphes.*

Host : *Imperata arundenacea.*

Locality record : Taipei.

*A.* ***sacchari*** (Hall 1923)

Minist. Agr. Egyt. Tech, Sci. Serv. Bull. 36 : 23, fig., *Lepidosaphes* ; Takahashi 1931 Trans. N. H. Soc. Formosa 21 : 2, *Lepidosaphes* ; Balachowsky 1954 Les Cochenilles Palearctiques Tribu Diaspini : 108, *Acanthomytilus.*

Host : *Miscanthus* sp.

Locality record : Taipei.

*A.* ***vermiformis*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 43 : 12, Figs., *Chionaspis* ; Borchsenius 1964 Ent. Obozr. 43 : 168, *Takahashiella* ; Takagi 1970 Ins. Mats. 33 : 27, *Acanthomytilus.*

Host : Bamboo.

Locality record : Yangmingshan, Shuishe, Chiayi.

Genus ***Andaspis*** MacGillivray 1921

Coccidae : 275 and 292 ; Takagi 1970 Ins. Mats. 33 : 20 ; Prabhaker Rao and Ferris 1952 Microentomology 17 : 17—32 ; Williams 1963 Bull. Brit. Mus. (Nat. Hist. ) Ent. 15 : 25. Type : *Mytilaspis flava* var. *hawaiiensis* Maskell 1894.

Syn. : *Raoaspis* Borchsenius 1958, *Pararoaspis* Borchsenius 1967.

*A.* ***crawii*** (Cockerell 1896)

Psyche 7, suppl. 21, *Mytilaspis* ; Kuwana 1925 Dept. Finance Imp. Plant Quar. Serv. Bull. 2 : 15, *Lepidosaphes* ; Takagi 1970 Ins. Mats. 33 : 21, *Andaspis.*

Syn. : *Mytilaspis crawii* var. *canaliculata* Maskell 1897.

Hosts : *Castanopsis kusanoi, Pasania uraiana (Lithocarpus uraiana)*

Locality record : Fenchifu, Alishan.

*A.* ***hawaiensis*** (Maskell 1894)

Trans. N. Z. Inst. 27 : 47, *Mytilaspis flava* var. *hawaiensis.*

Host : *Pirus serotina.*

Locality record : Shihlin.

*A.* ***mori*** Probhaker Rao and Ferris 1952

Microentomology 17 : 21 ; Williams 1963 Brit. Mus. (Nat. Hist. ) Ent. Bull. 15 : 20.

Host : *Sapindus* sp.

Locality record : Taipei.

*A.* ***viticis*** Takagi 1970

Ins. Mats. 33 : 22.

Host : *Vitex negundo.*

Locality record : Henchun.

Genus ***Cocomytilus*** Leonardi 1898

Riv. Pat. Veget 6 : 205 and 206 ; Ferris 1941 Microentomology 6 : 12 and 15, fig. 6. Type : *Mytilaspis convexa* Maskell 1894

*C.* ***albus*** (Cockerell)

Ferris 1941 Atlas Scale Insects N. Amer. SIII—271, *Aonidomytilus albus* ( Cockerell) ; Takahashi 1935 Trans. N. H. Soc. Formosa 25 ; 444, *Cocomytilus dispar* Vayssiese.

Syn. : *Cocomytilus dispar* (Vayssiese 1913) *Mytilaspis., Lepidosaphes cockerelliana* Kirkaldy.

Host : *Mamihot esculenta*

Locality record : Tainan.

Genus ***Dinaspis*** Leonardi 1911

Boll. Lab. Portici 5 : 282. Type : *Dinaspis ichesii*, Leonardi 1911.

*D.* ***taiwana*** Takahashi 1936

Trans. N. H. Soc. Formosa 26 : 427, fig.

Host : *Actinodaphne pedicellata.*

Locality record : Hsintien.

Genus ***Eucornuaspis*** Borchsenius 1963

Zool. Zhurn. 42 : 1168, fig. Type : *Lepidosaphes machili* (Maskel 1898)

***E. machili*** (Maskell 1898)

Trans N. Z. Inst. 30 ; 230, *Mytilaspis*; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 74, *Lepidosaphes cymbidicola* Kuwana ; 1933 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 48, fig., *Lepidosaphes cinnomomi* ; 1955 Bull. Univ. Osaka Prefect 5 (B) : 75, fig. *Lepidosaphes.*

Syn. : *Lepidosaphes cymbidicola* Kuwana 1925, *Lepidosaphes ezokihadae* Kuwana 1932, *Lepidosaphes cinnomomi* Takahashi 1933.

Hosts : *Cinnomum kanehirai, Cycas revolata.*

Locality record : Taipei, Hsintien, Hsinhua.

Genus ***Howardia*** Berlese and Leonardi 1896

Riv. Patol Veget 4 : 347 ; Ferris 1937 Microentomology 1 : 25 ; Takagi 1970 Ins. Mats. 33 : 31. Type : *Chionaspis biclavis* Comstock 1883.

Syn. : *Magalochiaspis* Paoli 1916.

***H. biclavis*** (Comstock 1883)

2nd Rept. Dept. Ent. Cornell Univ. : 98, *Chionaspis* ; Takagi 1970 Ins. Mats. 33 : 32, *Howardia.*

Host : *Lacuma nervosa.*

Locality record : Chiayi.

Genus ***Neopinnaspis*** McKenzie 1949

Bull. Calif. Dept. Agr. 38 : 123 ; Takagi 1970 ; Ins. Mats. 33 : 29. Type : *Neopinnaspis harperi* McKenzie 1949

***N. harperi*** McKenzie 1949

Bull. Calif. Dept. Agr. 38 : 123 ; Takagi 1970 Ins. Mats. 33 : 29.

Host : *Hibiscus rosa-sinensis.*

Locality record : Chiayi.

Genus ***Parainsulaspis*** Borchsenius 1963

Zool. Zhurn. 42 : 1162, fig. Type : *Lepidosaphes laterochitinosa* Green 1925= *Cephalaspis cocculi* Green 1896.

***P. bladhiae*** (Takahashi 1931)

J. Soc. Trop. Agr. Formosa 3 : 379, fig. *Lepidosaphes* ; Takagi 1969 Akitsu 9 : 77, fig. ; Borchsenius 1963 Zool Zhurn. 42 : 1162, fig. *Parainsulaspis.*

Syn. : *Lepidosaphes kamakurensis* Kuwana 1925, misidentified, *Lepidosaphes laterochilienosa* Green 1925.

Host : *Bladhia sieboldii.*

Locality record : Taipingshan, Kuantzuling, Kaohsiung, Pingtung.

***P. glaucae*** (Takahashi 1932)

J. Soc. Trop. Agr. Formosa 4 : 47, *Lepidosaphes* ; Takagi 1960, 47 : 68 ; Borchsenius 1963 Zool Zhurn 42 : 1162, fig., *Parainsulaspis.*

Hosts : *Cyclobalanopsis glauca, Kandelia candel (rheedii)* , *Scolopia olhami.*

Locality record : Wulai, Shihlin, Lotung.

***P. kamakurensis*** (Kuwana 1925)

Dept. Finance Imp. Plant Quar. Serv. Bull. 2 : 18, *Lepidosaphes* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 75, *Lepidosaphes.*

Hosts : *Ardisia* sp., *Heptapleurum octophyllum, Heterosmilax japonica.*

Locality record : Shihlin, Chiayi.

Genus ***Ungulaspis*** MacGillivray 1921

Coccidae : 274, 286. Type : *Lepidosaphes ungulata* Green 1905

***U. ficicola*** (Takahashi 1932)

J. Soc. Trop. Agr. Formosa 3 : 378,

fig. , *Lepidosaphes.*

Host : *Ficus nervosa.*

Locality record : Hsintien.

Genus ***Diaspis*** Costa 1828

Prospetto di Una Nuova Divisione Metodica del Genero Coccus, Lin. Lam. Ec. Napoli, Dala Tipografia Trani : 6—7, nomen nudum. Type : *Diaspis calyptroides* Costa 1835=*Aspidiotus echinocacti* Bouche 1833.

Syn. : *Carulaspis* MacGillivray 1921, *Cockerellaspis* MacGillivray 1921, *Umbaspis* MacGillivray 1921, *Ferrisidiaspis* Bodenheimer 1951, *Epidiaspis* Cockerell 1899, *Furchdaspis* MacGillvray 1921

***D. boisduvali*** Signoret 1869

Ann. Soc. Ent. France 4 : 432 ; Takahashi 1934 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 6.

Host : *Rhynchostylis retusa.*

Locality record : Taipei.

***D. bromeliae*** (Kennicott 1778)

Naturg : 20 : 52, *Coccus.*

Host : *Ananas comosus.*

Locality record : Taipei, Chiayi, Fengshan, Pingtung, Chuchi, Taishu.

***D. manni*** (Green 1906)

Mem. Dept. Agr. India Ent. 1 : 344, pl. 16 and 17, *Chionaspis* ; Takahashi 1930 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 37, *Phenacaspis* ; 1931 Bull. Ent. Res. 22 : 211, fig. *Diaspis gordoniae* ; 1933 Dept. Agr. Gov't. Res. Inst. Formosa, Rept. 60 : 60 ; 1934 Dept. Agr. Gov't. Res. Inst, Formosa Rept. 63 : 6, *D. manni.*

Syn. : *Diaspis gordoniae* Takahashi 1931.

Host : *Gordonia axillaris.*

Locality record : Taipei, Shuishe.

Genus ***Unaspis*** MacGillivray 1921

Coccidae : 308, 339 ; Prabhaker Rao 1949 Microentomology 14 : 36—42. Type : *Chionaspis acuminata* Green 1899.

Syn. : *Ametrochaspis* MacGilliaray1921, *Graphaspis* MacGilliaray 1921, *Prontaspis* MacGillivary 1921.

***U. turpiniae*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 10, fig. *Unaspis acuminata* var. ; Probhaker Rao 1949 Microentomology 14 : 64, a sp. not var. ; Takahashi 1956 Annot. Zool. Japan 29 : 58, further characters.

Host : *Turpinia formosana.*

Locality record : Pahsienshan.

***U. aei*** Takagi 1970

Ins. Mats. 33 : 35.

Host : *Euonymus echinatus.*

Locality record : Alishan.

Genus ***Thysanofiorinia*** Balachowsky 1954

Cochenicelle Palearct Trib. Diaspini : 312, figs. Type : *Fiorinia nephalii* Maskell 1898.

***T. nephalii*** (Maskell 1898)

Trans. N. Z. Inst. 30 : 234, *Fiorinia* ; Ferris 1936 Microentomology 1 : 5 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 77 ; Takagi 1970 Ins. Mats. 33 : 37, *Thysanofiorinia.*

Syn. : *Fiorinia hirsuta* Marchal 1906.

Hosts : *Euphoria longana, Lichi chinensis.*

Locality record : Yuanshan, Changhua, Chiayi, Kenting, Ilan.

Genus ***Duplachionaspis*** MacGillivray 1921

Coccidae : 307 and 332 ; Takagi 1970 Ins. Mats. 33 : 38. Type : *Chionaspis graminis* Green 1926.

Syn. : *Nelaspis* Hall 1946.

***D. divergens*** (Green 1899)

Coccidae Ceylon : 2 : 123, *Chionaspis graminis* Green var. *divergens* ; Takahashi 1929 Dept. Agr, Gov't. Res. Inst. Formosa Rept. 40 : 73 ; Takagi 1970 Ins. Mats. 33 : 39, *Duplachionaspis divergens.*

Syn. : *Chionaspis miscantheae* Kuwana 1928

Hosts : *Arundo formosana, Spinifex littoreus.*

Locality record : Taipei, Hsintien, Tanshui.

***D. stanotophri*** (Cooley 1899)

Spec. Bull. Mass. Expt. : 35, *Chionaspis* ; Takhashi 1929 Dept, Agr. Gov't. Res. Inst. Formosa Rept. 40 : 73.

Syn. : *Chionaspis graminis* var. *aegyptica* Hall 1923.

Host : *Saccharum officinarum.*

Locality record : Tainan, Taitung.

## Genus ***Pseudaulacaspis*** MacGillivray 1921

Coccidae : 305 ; Ferris 1941 Microentomology 6 : 19, fig. 10. Type : *Diaspis pentagona* Targioni-Tozzitti 1886.

Syn. : *Euvoraspis* Mamet 1951, *Sasakiaspis* Kuwana 1926.

***P. brideliae*** (Takahashi 1933)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 43, fig., *Chionaspis* ; Ferris 1955 Microentomology 20 ; 45, *Phenacaspis.*

Host : *Eridelia.*

Locality record : Hsintien, Kueitzuchiao.

***P. cockerelli*** (Cooley 1897)

Can. Ent. 29 : 278., *Chionaspis* ; Takagi 1969 Ins. Mats. 32 : 43, *Pseudaulacaspis.*

Syn. : *Chionaspis akebiae* Takahashi 1952, *C. ancubae* Cooley 1897, *C. dilatata* Green 1898, *C. eugeniae* Maskell, *C. miyakoensis* Kuwana 1931, *C. syringae* Borchsenius 1938, *C. hattorii* Kanda 1941, *Phenacaspis natalensis* Cockerell 1902, *P. eugeniae* var. *sandwicensis* Fullaway 1932, *P. ferrisis* Mamet 1959, *Pseudaulacaspis biformis* Takagi 1956.

Hosts : *Bischofia javanica, Camellia* sp., *Eurya acuminata, E. crenatifolia, E. japonica, E. strigillosa, Excoecaria orientalis, Liquidambar formosana, Michelia alba, M. fuscata, Nerium indica, Phoenix, Rhododendren* spp., *Trochodendran aralioides, Viburnum arboricalum, V. odoratissium.*

Locality record : Taipei, Yangmingshan, Chiayi, Alishan, Kaohsiung, Kenting.

***P. kuwanai*** Takahashi 1956

Bull. Lab. Zool. Portici 33 : 50 n. n. for *quercus* Kuwana nec Comstock from *Phenacaspis*, Kuwana 1931 Sci. Bull. Ministr. Agr. For. Japan 2 : 6, fig., *Phenacaspis* ; Ferris 1955 Microentomology 20 : 50. *Phenacaspis.*

Syn. : *Phenacaspis quercus* Kuwana 1931 nec *Chionaspis quercus* Comstock 1881.

Host : unknown.

Locality record : Kenting.

***P. major*** (Cockerell 1894)

Ent. News 5 : 43, *Aulacaspis*, Zimmerman 1949 Ins. Hawaii 5 : 381, *Diaspis.*

Syn. : *Aulacaspis flacourtiae* Rutherford 1914, *Pseudaulacaspis euphorbiae* de Charmoy 1899, *P. hwangensis* Chen 1937.

Hosts : *Ficus beecheyana, Flacourtia ramontchii, Scolopia oldhamii* (=*crenata*).

Locality record : Taipei, Ouluanpi.

***P. megacauda*** Takagi 1970

Ins. Mats. 33 : 48.

Host : *Eurya acuminata.*

Locality record : Alishan.

***P. pentagona*** (Targioni-Tozzetti 1855)

Revista Bacchicoltura 11, *Diaspis*; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 93, *Diaspis*; Ferris 1921 Bull. Ent. Res. 12 : 213, *Aulacaspis*; Takahashi 1929 Dept. Agr. Gov't. Res . Inst. Formosa Rept. 40 : 72, *Diaspis*; Takagi 1961 Ins. Mats. 24 : 88, *Aulacaspis*; 1970 Ins. Mats. 33 : 42, *Pseudaulacaspis*.

Hosts : *Crotalaria, Mallotus japonicus, Morus alba, Prunus communis, P. persicae, Stranovaesisnii niitakayamensis*.

Locality record : Taipei, Hsintien, Yangmingshan, Taoyuan, Pingchien, Chiayi, Tungpu, Kuantzuling, Pashienshan, Tainan, Fengshan, Hualien.

***P. sasakawai*** Takagi 1970

Ins. Mats. 33 : 48.

Host : *Stauntonia heitaoensis, Symplocos lancifolia, S. stellaris*.

Locality record : Alishan.

***P. taiwana*** (Takahashi 1935)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 17, fig., *Phenacaspis*.

Host : *Quercus*.

Locality record : Suo.

***P. takahashii*** (Ferris 1955)

Microentomology 20 : 52, figs. *Phenacaspis*; Takagi 1970 Ins. Mats. 33 : 70, *Pseudaulacaspis*.

Host : *Diospyros discolor*.

Locality record : Kenting.

Genus ***Epifiorinia*** Takagi 1970

Ins. Mats 33 : 52. Type : *Epifiorinia tsugae* Takagi 1970

***E. tsugae*** Takagi 1970

Ins. Mats. 33 : 53.

Host : *Tsuga chinensis* var. *formosana*

Locality record : Tungpu.

Genus ***Fiorinia*** Targioni-Tozzetti 1868

Atti. Soc. tal. Scil. Ent. 11 : 755 ; Takagi 1970 Ins. Mats. 33 : 53. Type : *Fiorinia pellucida* Targioni-Tozzetti 1868 =*Diaspis fioriniae* Targioni Tozzetti 1867.

Syn. : *Uhleria* Comstock 1883.

***F. arengae*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 26, *Fiorinia taiwana* var. *arengae*; Takagi 1970 Ins. Mats. 33 : 59.

Host : *Arenga engleri*.

Locality record : Kenting.

***F. fioriniae*** (Targioni-Tozzetti 1867)

Studi sul Cocc. : 14, *Diaspis*; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 76 ; Takagi 1970 Ins. Mats. 33 : 59.

Syn. : *Fiorinia pellucida* Targioni 1869, *F. camelliae* Comstock 1881, *F. palmae* Green 1896.

Hosts : *Buchanania arborascens, Camellia japonica, Cinnamomum* sp., *Decaspermum fruticosum, Eucalyptus* sp., *Eugenia javanica, Ficus nervosa, Machilus kusanoi, Mangifera indica, Myristica heterophylla*.

Locality record : Taipei, Chiayi, Chuchi.

***F. formosensis*** Takahashi 1933

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 50, Takagi 1970 Ins. Mats. 33 : 61.

Hosts : *Ficus foveolata, F.* sp.

Locality record : Yangmingshan.

***F. horii*** Kuwana 1927

Annot Zool. Japan 2 : 151, figs.

Hosts : *Rhododendron lasiostylum* (= *sasakii*), *R. hymnathes* var. *heptamerum*, var. *rentamerum*, var. *angustifolia*.

Locality record : Taiwan.

***F. japonica*** Kuwana 1902

Proc. Calif. Ac. Sci. 3, 3 : 79, *Fiorinia fioriniae* var. *japonica*; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept.

40 : 76 ; Ferris 1936 Microentomology 1:4 ; Takagi 1970 Ins. Mats. 33 : 56.

Syn. : *Fiorinia juniperi* Leonard 1906.

Hosts : *Keleteeria davidiana, Pinus thunbergii, Podocarpus macrophylla, Taxus mairei.*

Locality record : Taipei, Yuanshan.

***F. linderae*** Takagi 1970

Ins. Mats. 33 : 64.

Host : *Lindera communis*

Locality record : Taipei.

***F. minor*** Maskell 1897

Trans N. Z. Inst. 29 : 307, *Fiorinia camelliae* var. *minor* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 77 ; Ferris 1921 Bull. Ent. Res. 12 : 216, *Fiorinia chinensis* ; 1936 Microentomology 1 : 4, *Fiorinia minor* ; Takagi 1970 Ins. Mats. 33 : 63.

Syn. : *Fiorinia chinensis* Ferris 1921.

Hosts : *Camellia, Celtis chinensis, Ficus,* Palm.

Locality record : Taipei, Yangmingshan.

***F. pinicola*** Maskell 1897

Ent. Mon. Mag. 33 : 242 ; Ferris 1936 Microentomology 1 : 2 ; Takagi 1970 Ins. Mats. 33 : 56.

Hosts : *Cupressus juniperinus, Podocarpus.*

Locality record : Taipei.

***F. proboscidaria*** Green 1900

J. Bombay N. H. Soc. 13 : 256 ; Takagi 1970 Ins. Mats. 33 : 65.

Hosts : *Citrus* sp., *Eugenia jambos.*

Locality record : Chiayi, Kuantzuling.

***F. proboscidaria*** var. ***randiae*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 20.

Host : *Randia canthioides.*

Locality record : Puli.

***F. rhododendri*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 27.

Host : *Rhododendron* sp.

Locality record : Chihpen.

***F. smilaceti*** Takahashi 1931

Bull. Ent. Res. 22 : 218 ; 1934 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 24.

Hosts : *Lindera communis, Smilax* sp.

Locality record : Hsintien.

***F. taiwana*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 24 ; Takagi 1970 Ind. Mats. 33 : 57.

Syn. : *Fiorinia saprosmae* Green 1896

Hosts : *Arenga engleri, Chrysalidocarpus lutescens, Cyclobalanopsis glauca, Myrica rubra.*

Locality record : Kenting.

***F. theae*** Green 1900

Ind. Mus. Notes 5 : 3, pl. 1, figs. 4—8 ; Sasscer 1912 U. S. D. A. Ent. Tech. 16 : 76, Pls. 10—11 ; Shiraki 1913 Agr. Expt. Stat. Formosa Spec. Rept. 8 : 95, *Chionaspis flava* Shiraki nec Green ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 76 ; Takagi 1970 Ins. Mats. 33 : 65.

Hosts : *Citrus* spp., *Eurya japonica, Thysanospermum diffucum.*

Locality record : Taipei, Yangmingshan, Chiayi, Matou. Fengshan, Pingtung.

***F. theae*** var. ***turpiniae*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 21 ; Ferris 1950 Microentomology 15 : 78, 93, fig. 43.

Host : *Turpinia formosana.*

Locality record : Pahsienshan.

***F. vaccini*** Kuwana var. ***hisakakii*** Takahashi 1936

Mushi 9 : 7.
Host : *Eurya* sp.
Locality record : Kaohsiung.

Genus ***Achionaspis*** Takagi 1970

Ins. Mats. 33 : 67. Type : *Achionaspis kanoi* Takagi 1970

***A. kanoi*** Takagi 1970
Ins. Mats. 33 : 67.
Host : *Eurya japonica.*
Locality record : Taipei

Genus ***Chionaspis*** Signoret 1868

Ann. Soc. Ent. France (ser.4) 8 : 844 ; Takagi 1970 Ins. Mats. 33 : 69. Type : *Coccus salicis* Linnaeus 1758.

Syn. : *Fundaspis* MacGillivray 1921, *Marchalaspis* MacGillivray 1921, *Marchaliella* Bodenheimer 1951, *Phenacaspis* Cooley and Cockerell 1899.

***C. atlanticae*** Takahashi 1933
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 44 ; Ferris 1935 Microentomology 20 : 45, fig. 31, *Phenacaspis.*
Host : *Severinia buxifolia* (=*Atlantia bilocularis*)
Locality record : Kenting.

***C. formosana*** (Takahashi 1934)
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 7, *Phenacaspis.*
Host : *Wickstroemia* sp.
Locality record : Lotung, Pingtung.

***C. machili*** (Takahashi 1931)
Trans. N. H. Soc. Formosa 21 : 1, *Diaspis* ; Takagi 1970 Ins. Mats. 33 : 72, *Chionaspis.*
Syn. : *Phenacaspis obovats* Takagi and Kawai 1966.
Hosts : *Cinnamomum* sp., *Machilus japonica, M. kusanoi.*
Locality record : Taipei, Yuanshan, Yangmingshan, Taipingshan, Shuishe, Kuantzuling, Fenchifu, Kenting.

***C. machilicola*** (Takahashi 1935)
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 13, fig., *Diaspis.*
Host : *Machilus* sp.
Locality record : Chihpen.

***C. machilicola*** (Takahashi 1935) var. ***cinnamomicola*** Takahashi 1935.
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 15, *Diaspis* ; Takagi 1970 Ins. Mats. 33 : 79, *Chionaspis* sp.
Host : *Cinnamomum erythrophloia* (*Beilschmiddra*) .
Locality record : Taipei.

***C. rotunda*** (Takahashi 1935)
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 16, *Phenacaspis.*
Host : *Quercus pseudomyrsimaefolia.*
Locality record : Pingtung.

***C. schizosoma*** Takagi 1970
Ins. Mats. 33 : 77.
Hosts : *Machilus japonica, M. kusanoi, M.* sp.
Locality record : Yangmingshan, Chiayi, Chuchi, Kenting.

***C. sozanica*** Takahashi 1933
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 60 : 41 ; Takagi 1970 Ins. Mats. 33 : 70.
Host : *Acer* sp.
Locality record : Yangmingshan.

***C. takahashii*** (Ferris 1955)
Microentomology 20 : 52, *Phenacaspis.*
Host : unknown.
Locality record : Taipei, Yuan Fungshi

***C. trochodendri*** (Takahashi 1936)
Mushi 9 : 4, fig., *Phenacaspis* ; Takagi 1970 Ins. Mats. 33 : 74, *Chionaspis.*
Host : *Trochodendron aralioides.*
Locality record : Alishan.

***C. uenoi*** Takagi 1970
Ins. Mats. 33 : 74.

Host : *Lindera communis.*

Locality record : Fenchifu.

***C. vitis*** Green 1896

Ind. Mus. Notes 4 : 3 ; 1899 Coccidae Ceylon : 140, pl. 47 ; 1930 Tijdschr. Ent. 73 : 295, fig., notes on scale ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 72.

Hosts : *Acalypha kotoensis, Elaeagrus glabra, E. lotoensis=E. macrophylla, E. thunbergii, Kandelia rheedi(=candel), Mallotus philippensis, Machilus* sp.

Locality record : Taipei, Yuanshan, Peitau, Yangmingshan, Tungshe, Puli, Shuishe, Lanhsu.

Genus ***Greenaspis*** MacGillivray 1921

Coccidae : 307, 339 ; Ferris 1952 Microentomology 17 : 6 ; Takagi 1970 Ins. Mats. 33 : 81. Type : *Mytilaspis elongata* Green 1896.

Syn. : *Canaspis* MacGillivray 1921.

***G. bambusifoliae*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 14, figs., *Chionaspis* ; Ferris 1952 Microentomology 17 : 7, *Greenaspis.*

Host : Bamboo.

Localityrecord : Taipei, Erhshui, Shuishe.

***G. elongata*** (Green 1899)

Coccidae Ceylon : 125, pl. 39, *Chionaspis* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 73 ; Takagi 1970 Ins . Mats. 33 : 81, *Greenaspis.*

Syn. : *Greenaspis yunnanensis* Ferris 1952.

Hosts : Bamboo, *Phragmitis* sp.

Locality record : Taipei, Yangmingshan, Kenting.

Genus ***Aulacaspis*** Cockerell 1893

J. Inst. Jamaica 1 : 180 ; Scott 1952 Microentomology 17 : 20 ; Takagi 1970 Ins. Mats. 33 : 82. Type : *Aspidiotus rosae* Bouche 1834.

Syn. : *Miscanthaspis* Takagi 1961

***A. aceris*** Takahashi 1935

Gov't. Agr. Res. Int. Formosa Rept. 66 : 12.

Host : *Acer kawakamii.*

Locality record : Pingtung.

***A. actinidiae*** Takagi 1970

Ins. Mats. 33 : 99.

Host : *Actinidia arisanensis.*

Locality record : Fenchifu.

***A. actinodaphnes*** Takagi 1970

Ins. Mats. 33 : 89.

Host : *Actinodaphne mushaensis.*

Locality record : Alishan.

***A. alishana*** Takagi 1970

Ins. Mats. 33 : 89.

Host : *Neolistea acuminutissima.*

Locality record : Alishan.

***A. crawii*** (Cockerell 1898)

Psyche 8 : 190, *Diaspis* ; Takahashi 1930 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 43 : 37, *Aulacaspis* ; Scott 1952 Microentomology 17 : 36.

Syn. : *Aulacaspis fulleri* Cockerell 1901

Hosts : *Hibiscus tiliacens, Melia azedarach.*

Locality record : Taipei.

***A. difficilis*** (Cockerell 1896)

Psyche 7 suppl. : 21, *Chionaspis* ; Kuwana 1926 Dept. Finance Imp. Plant Quar. Serv. Japan Tech. Bul. 4 : 11, *Sasakiaspis* ; Takagi 1970 Ins. Mats. 33 : 98, *Aulacaspis.*

Host : *Elaeagus* sp.

Locality record : Yunlin.

***A. divergens*** Takahashi 1935

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 10, figs., *Aulacaspis kuzunoi* var. *divergens* ; Takagi 1970 Ins. Mats.

33 : 102. *divergens*.

Host : *Miscanthus* sp.

Locality record : Yunlin, Chuchi, Kuantzuling, Fenchifu.

*A.* ***fagraeae*** (Green 1896)

Coccidae Ceyoln 1 : 91, pl. 25, fig. 23, *Diaspis* ; Cockerell 1902 Ent. 35 : 59.

Host : *Fagraea* sp.

Locality record : Yuanshan, Alishan.

*A.* ***greeni*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 41, figs. ; Takagi 1970 Ins. Mats. 33 : 93.

Hosts : *Cinnamomum reticulatum, C.* sp.

Locality record : Ouluanpi.

*A.* ***madiumensis*** (Zehntner 1898)

Med. Proefstation Sucker. Oost-Java 36 : 1, *Chionaspis* ; Takahashi 1940 Mushi 13 : 26, *Aulacaspis* ; Scott 1952 Microentomology 17 : 38.

Syn. : *Scloptetaspis maidunensis* (Zehntner) MacGillivray 1921,

Hosts : *Saccharium officinarum, Oplismenus* sp.

Locality record : Taiwan.

*A.* ***maesae*** Takagi 1970

Ins. Mats. 33 : 95.

Host : *Maesa tonera*.

Locality record : Yangmingshan.

*A.* ***murrayae*** Takahashi 1931

Bull. Ent. Res. 22 : 212, fig. ; Takagi 1970 Ins. Mats. 33 : 92.

Host : *Murraya paniculata*.

Locality record : Taipei, Ilan, Kuantzuling, Kenting.

*A.* ***phoebicola*** Takahashi 1936

Trans. N. H. Soc. Formosa 26 : 81, fig.

Host : *Phoebe formosana*.

Locality record : Wulai, Pingtung, Taitung.

*A.* ***robusta*** Takahashi 1931

Bull. Ent. Res. 22 : 212, figs. ; Takagi 1970 Ins. Mats. 33 : 99.

Host : *Ardisia sieboldii* (*Bladhia*)

Locality record : Kuantzuling.

*A.* ***rosae*** (Boudhe 1834)

Natur. Insekt. : 14, *Aspidiotus* ; Maki 1915 Forest Expt. Sta. Formosa Spec. Rept. 1 : 28, *Diaspis* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 70, *Aulacaspis* ; Scott 1952 Microentomology 17 : 40.

Host : *Rosa* sp.

Locality record : Taipei.

*A.* ***saigusai*** Takagi 1970

Ins. Mats. 33 : 91.

Host : *Rhus floribunda paniculatus*.

Locality record : Alishan.

*A.* ***spinosa*** (Maskell 1897)

Ent. Mon. Mag. 33 : 241, *Diaspsis rosae* var. *spinosa* ; Takahashi 1931 J. Soc. Trop. Agr. Formosa 3 : 377, *Aulacaspis spinosa* ; Scott 1952 Microentomology 17 : 40 ; Takagi 1970 Ins. Mats. : 33 : 97.

Host : *Smilax* sp.

Locality record : Kuantzuling, Fenchifu.

*A.* ***tegalensis*** (Zehntner 1898)

Med. Proef. Suik. Oost. Java 36 : 7, *Chionaspis* ; Ferris 1921 Bull. Ent. Res. 12 : 213 *Aulacaspis* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 71 ; Scott 1952 Microentomology 17 : 40.

Host : *Saccharum officinarum*.

Locality record : Taipei.

*A.* ***tubercularis*** (Newstead 1906)

Bull. Ent. Res. 2 : 86, *Diaspis* ; Takahashi 1929 Dept. Agr. Gov't.Res.Inst.Formosa Rept. 40 : 71, *Aulacaspis mangiferae* ; 1935 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 66 : 12, *Aulacaspis mangiferae* var. *aceris*. Takagi 1970 Ins. Mats. 33 : 85,

*tuberculatus.*

Hosts : *Mangifera indica, Acer kawakamii.*

Locality record : Taipei, Shihlin, Peitau, Hsintien, Chuchi, Chiayi.

***A. yabunikkei*** Kuwana 1926

Dept. Finance Imp. Plant Quar. Ser. Tech. Bull. 4 : 32 ; Shiraki 1913 Agr. Expt. Stat. Formosa Spec. Rept. 8 : 97, *Parlatoria cingala* ; Maki 1915 Forest Expt. Sta. Formosa Spec. Rept.1 : 26, *Parlatoria cingala* ; Ferris 1921 Bull. Ent. Res. 12 : 212, *Aulacaspis cinnamomi* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 70.

Syn. : *Aulacaspis cinnamomi* Ferris 1921.

Hosts : *Actinodaphne* sp, *Lindera* sp, *Cinnamomum camphor, Neolistea* sp.

Locality record : Peitau, Hsintien, Chushan, Chiayi, Peipu, Kenting.

Genus ***Pinnaspis*** Cockerell 1892

J. Ent. Jamaica 1 : 136 ; Ferris and Rao 1947 Microentomology 12 : 25—58. Type : *Mytilaspis pandani* Comstock 1881=*Aspidiotus buxi* Bouche 1851.

Syn. : *Hemichionaspis* Cockerell 1897, *Jaapia* Lindinger 1914, *Lepidaspidis* Mac Gillivray 1921.

***P. aspidistrae*** (Signoret 1869)

Ann. Soc. Ent. France 9 : 443, *Chionaspis* ; Maki 1915 Forest Expt. Sta. Formosa Rept. 1 : 28 ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 73, *Pinnaspis.*

Syn. : *Chionaspis brasiliensis* Signoret 1896, *Chionaspis latus* Cockerell 1896, *Pinnaspis ophiopogonis* Takahashi 1952.

Hosts : *Aspidistra lurida, Asplenium nidus, Camellia sinensis, Eurya japoniaa.*

Locality record : Taipei, Hsintien.

***P. buxi*** (Bouche 1851)

Stett. Ent. Zeit. 12 : 111, *Aspidiotus* ; Takagi 1970 Ins. Mats. 33 : 105.

Syn. : *Hemichionaspis pseudaspidistrae* Green 1916 ; *Mytilaspis pandani* Comstock 1881, *Pinnaspis bambusae* Cockerell 1893, *Pinnaspis siphonodontis* Cockerell and Robinson 1915.

Host : *Pothos seemanii.*

Locality record : Kuantzuling.

***P. frontalis*** Takagi 1970

Ins. Mats. 33 : 115.

Host : *Eurya japonica.*

Locality record : Chuchi.

***P. hibisci*** Takagi 1970

Ins. Mats. 33 : 113.

Host : *Hibiscus rosae sinensis, H. taiwanensis, Brehmeria densoflora.*

Locality record : Chiayi, Kuantzuling, Henchun.

***P. konoi*** (Takahashi 1935)

Trans. N. H. Soc. Formosa 25 : 444, *Cocomytilus.*

Host : an undetermined tree branch.

Locality record : Lanhsu.

***P. lithocarpi*** Takahashi 1931

Bull. Ent. Res. 22 : 214, fig.

Host : *Lithocarpus* sp.

Locality record : Puli, Shuishe.

***P. liui*** Takagi 1970

Ins. Mats. 33 : 110

Hosts : *Adinandra lasiostyla, Eurya cuminata, E. strigillosa.*

Locality record : Alishan.

***P. strachani*** (Cooley 1899)

Hatch. Expt. Sta. Mass. Agr. Coll. Spec. Bull. : 54, *Hemichionaspis minor strachani* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 74, *Pinnaspis minor.*

Syn. : *Hemichionaspis aspidistrae* var. *gossypii* Newstead 1908, H. *marchali* Cockerell 1902, *H. townsendi* Cockerell

1905. *Pinnaspis gossypii* Hall 1946, *P. machalli* Hall 1946, *P. temporaria* Ferris 1942

Hosts : *Pouteria obovata*, *Sansevieria* sp.

Locality record : Taipei, Kenting.

***P. muntingi*** Takagi 1965

Kontyu 33 : 446 ; 1970 Ins. Mats. 33 : 107.

Hosts : *Ficus swinhoei*, *Musa sapiens*.

Locality record : Ouluanpi.

***P. shirozui*** Takagi 1970

Ins. Mats. 33 : 111.

Host : *Ficus cuspidatocaudata*.

Locality record : Henchun.

***P. uniloba*** (Kuwana 1909)

J. N. Y. Ent. Soc. 17 : 156, *Mytilaspis* (*Lepidosaphes*) ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 74.

Syn. : *Pinnaspis simplex* Ferris 1921.

Hosts : *Adinandra milletti*, *Camellia japonica*, *Cleyera japonica*, var. *C. japonica* var. *morii*, *Eurya japonica*, *Osmanthus fragrans*.

Locality record : Taipei, Hsintien, Peitau, Yangmingshan, Shihting, Puli, Kuantzuling, Ouluanpi.

***P. theae*** (Maskell 1891)

Indian Mus. Notes 2 : 60, *Chionaspis* ; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 98, *Chionaspis* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 74, *Pinnaspis*.

Syn. : *Chionaspis separata* Green 1900.

Hosts : *Camellia japonica*, *C. sinensis*.

Locality record : Kuantzuling, Henchun.

Genus ***Afiorinia*** Takagi 1970

Ins. Mats. 33 : 118. Type : *Afiorinia hirashimai* Takagi 1970.

***A. hirashimai*** Takagi 1970

Ins. Mats. 33 : 118.

Host : *Castanopsis kusanoi*.

Locality record : Fenchifu.

Genus ***Ichthyaspis*** Takagi 1970

Ins. Mats. 33 : 120

Type : *Adiscofiorinia ficicola* Takahashi 1931.

***I. ficicola*** (Takahashi 1931)

J. Soc. Trop. Agr. Formosa 3 : 380, *Adiscofiorinia* ; Takagi 1970 Ins. Mats. 33 : 120, *Ichthyaspis*.

Hosts : *Ficus foveolata*, *F.* sp.

Locality record : Yangmingshan.

Genus ***Kuwanaspis*** MacGillivray 1921

Coccidae : 311 and 361 ; Takagi 1970 Ins. Mats. 33 : 121. Type : *Chionaspis hikosani* Kuwana 1902.

Syn. : *Tsukushiaspis* Kuwana 1928 ; *Lepidosaphoides* Lindinger 1930.

***K. amandalei*** (Green 1919)

Rec. Ind. Mus. 16 : 434, *Chionaspis* ; Ferris 1921 Bull. Ent. Res. 12 : 213.

Host : *Bambusa stenostachya*.

Locality record : Taipei.

***K. arundinariae*** Takahashi 1938

Mushi 11 : 42, figs.

Host : *Pleioblastus* sp.

Locality record : Taipingshan.

***K. bambusifoliae*** (Takahashi 1934)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 11, figs., *Tsukushiaspis*.

Host : Bamboo.

Locality record : Taipei.

***K. elongata*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept . 48 : 18, *Tsukushiaspis*.

Host : Bamboo.

Locality record : Shuishe.

***K. formosana*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 23, *Tsukushiaspis.*

Host : Bamboo sheath stem.

Locality record : Shuishe

***K. neolinearis*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 49 : 21, figs., *Tsukushiaspis* ; Takagi 1970 Ins. Mats. 33 : 125, *Kuwanapis.*

Host : Bamboo.

Locality record : Yangmingshan, Shuishe.

***K. phragmitis*** Takahashi 1931

Bull. Ent. Res. 22 : 216, fig.

Host : *Phragmitis* sp.

Locality record : Suo, Chihpen.

***K. pseudoleucaspis*** (Kuwana 1902)

P. Cal. Ac. Sci. 3, 3 : 74, pl. 13, figs. 75—81, *Leucaspis bambusae* ; Ferris 1953 Microentomology 18 : 60, fig. 24 ; Takagi 1970 Ins. Mast. : 33 : 122, *Kuwanaspis.*

Syn. : *Leucaspis bambusae* Kumana 1902 nec *Chionaspis bambusae* Cockerell 1896.

Host : Bamboo.

Locality record : Yangmingshan.

***K. suishana*** (Takahashi 1930)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 49 : 16, fig., *Tsukushiaspis* ; Takagi 1970 Ins. Mats. 33 : 123, *Kuwanaspis.*

Host : *Phyllostachys pubescens.*

Locality record : Taipei, Yangmingshan.

***K. vermiformis*** (Takahashi 1931)

Bull. Ent. Res. 23 : 215, *Tsukushiaspis*; Takagi 1970 Ins. Mats. 32 : 125, *Kuwanaspis.*

Hosts : *Bambusa stenostachya, Sinocalamus latiflorus=Dendrocalamus latiflorus, Sinocalamus oldhmai.*

Locality record : Taipei, Chiayi, Chuchi.

Genus ***Formosaspis*** Takahashi 1932

J. Soc. Trop. Agr. Formosa 4 : 47. Type : *Protodiaspis nigra* Takahashi 1930=*takahashii* Lindinger 1932.

***F. formosanus*** (Takahashi 1931)

Trans. N. H. Soc.Formosa 21 : 2, *Leucaspis* ; 1932 J. Sco. Trop. Agr. Formosa 4 : 47, *Formosaspis.*

Host : Bamboo.

Locality record : Erhshui.

***F. takahashii*** Lindinger 1932

Konowia 11 : 186, *Crypthemichionaspis takahashii* n. n. for *nigra* ; Takahashi 1930 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 25, fig. . *Protodiaspis nigra* ; 1932 J. Soc. Trop. Agr. Formosa 4 : 47, *Formosaspis.*

Host : Bamboo.

Locality record : Erhshui.

Genus ***Nikkoaspis*** Kuwana 1928

Sci. Bull. Mistr. Agr. For. Tokyo 1 : 37. Type : *Nikkoaspis shiranensis* Kuwana 1928

***N. hichiseiana*** (Takahashi 1934)

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 63 : 12, fig., *Tsukushiaspis.*

Hosts : *Arundo formosana, Phragmites* sp.

Locality record : Taipei.

Genus ***Megacanthaspis*** Takagi 1970

Ins. Mats. 33 : 128. Type : *Megacanthaspis actinodaphnes* Takagi 1961.

***M. litseae*** Takagi 1970

Ins. Mats. 33 : 130.

Host : *Litsea akoensis.*

Locality record : Fenchifu.

Genus ***Poliaspis*** Maskell 1880

Trans N. Z. Inst. 2 : 293 ; Ferris 1938 Microentomology 3 : 17, 42, fig. 21. Type : *Poliaspis media* Maskell 1880.

Syn. : *Fusilaspis* MacGillivray 1921, *Salaspis* Hall 1946.

***P. pini*** (Maskell 1897)
Ent. Mon. Mag. 33 : 242 ; 1898 Trans. N. Z. Inst. 30 : 231 ; Kuwana 1902 Proc. Calif. Ac. Sci. 3, 3 : 32 ; 1925 Dept. Finance Japan Imp. Plant Quar. Tech. Bull. 1 : 1.
Host : *Pinus thunbergi.*
Locality record : Taiwan.

Genus ***Quernaspis*** Ferris 1937

Atlas Scale Insects N. Amer. SI—118. Type : *Chionaspis quercus* Comstock 1881.

***Q. lithocarpi*** (Takahashi 1931)
Bull. Ent. Res. 22 : 214, *Pinnaspis.*
Host : *Lithocarpus* sp.
Locality record : Puli, Shuishe.

## Family ERIOCOCCIDAE

Genus ***Eriococcus*** Targioni-Tozzetti 1868

Atti Soc. Ital. Sci. Nat. 11 : 726 ; Ferris 1948 Haiwaiian Insects 5 : 282 ; 1955 Atlas Scale Ins. N. Amer. 7 : 94. Type : *Coccus buxi* Fonscolombe 1834.

Syn. : *Gossypraia* Signoret 1875, *Rhizococcus* Signoret 1875, *Acanthococcus* Signoret 1875, *Uhleria* Cooke 1881.

***E. transversus*** Green 1922
Coccidae Ceylon 5 : 351.
Host : Bamboo.
Localty record : Shuishe.

## Family KERMESIDAE

Genus ***Kermes*** Latreille 1798

Bull. Soc. Philom Paris 1 : 113. Type : *Coccus variegatus* Gmelin 1789.

Syn. : *Talla* von Heyden. 1860

***K. formosanus*** Takahashi 1929
Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 49.
Host : *Quercus* sp.
Locality record : Sungkang (Tattaka).

## Family LACCIFERDAE

Genus ***Laccifer*** Oken 1815

Lehrbuch der Naturgeschichte Sec. 3 ( Zool. 1) : 430. Type : *Laccifer lacca* Kerr 1782

***L. greeni*** (Camberlin 1923)
Bull. Ent. Res. 14 : 168, *Tachardia* ; Takahashi 1928 Trans. Nat. Hist. Soc. Formosa 18 : 261, *Laccifer.*
Syn. : *Tachardia fici* Morrison 1920.
Hosts : *Averrhoa carambola, Calliandra haematocephala, Euphoria longana, Ficus wightiana, Heritera littorlis, Liquidambar formosana, Machilus* sp., *Mangifera indica, Palaquium formosanum, Platanus orientalis, Rhodomyrtus tomentosa.*
Locality record : Chiayi, Kenting.

***L. lacca*** (Kerr 1782)
Philos Trans. 71 : 374, *Coccus* ; Chamberlin 1923 Bull. Ent. Res. 14 : 170, *Tachardina.*
Hosts : *Ficus, Lichi chinensis, Hibiscus rosa-sinensis, Cajanus cajan.*
Locality record : Taipei, Taichung, Chiayi, Fengshan, Pingtung.
Note : This species was the second time introduced from Siam, Thailand for producing lac but did not use it and now becoming a pest of a nut fruit, Lichi.

Genus ***Tachardina*** Cockerell 1901

Entomologist 34 : 294. Type : *Tachardia albida* Cockerell 1901.

***T. theae*** Green and Mann 1907
Mem. Dept. Agr. Ind, Ent. Ser. 1 : 348 ; 2 : 28, *Tachardina decorella* var. *theae* ; Takahashi 1928 Philip. J. Sci. 36 : 347, *Tachardina theae* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 69.
Hosts : *Ardisia sieboldi, Ficus retusa, Machilus* sp., *Michelia formosana, M. fuscata, M. longifolia, Myrica rubra, Camellia chinensis, Rhodomyrtus tomentosa, Schima* sp.
Locality record : Taipei, Pingchien, Chiayi.

## Family LECANODIASPIDAE

Genus ***Lecanodiaspis*** Targioni-Tozzetti 1869

Soc. Ent. Ital. Bull. 1 : 261. Type : *Lecanodiaspis sardoa* Targioni-Tozzetti 1869.

***L. cremastogastri*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 47.

Host : *Lithocarpus* sp.

Locality record : Puli.

## Family MARGARODIDAE

Genus ***Drosicha*** Walker 1858

List of the specimens of Homopterous Insects in the Collection of the British Museum Supplement : 306. Type : *Drosicha contrahens* Walker 1858.

Syn. : *Cockerellella* MacGillivray 1921. *Warajicoccus* Kuwana 1920, *Greenacoccus* MacGillivray 1921, *Greeniella* MacGillivray 1921.

***D. contrahens*** Walker 1858

Cat. Br. Mus. Hom. 4, Suppl. : 306 ; Green 1922 Coccidae Ceylon : 431. pl. 1976, *Monophlaenus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 31.

Host : *Persea gratissima.*

Locality record : Chiayi.

***D. dalbergiae*** (Green 1902)

Ind. Mus. Notes 5 : 101, *Monophlebus*; Proc. 5th Ent. Meet, Pusa : 338, *Monophlebus* ; Takahashi 1928 Philip. J. Sci. 36 : 329 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 31, *Drosicha.*

Host : unknown.

Locality record : Wulai, Tanshui.

***D. maskelli*** Cockerell 1902

The nomenclature of the Monophlebine Coccidae, Science (n. s. ) 15 : 717 ; Morrison 1923 Proc. U. S. Nat. Mus. 62, art. 17 : 2 ; Takahashi 1928 Philip. J. Sci. 36 : 328.

Host : *Ficus retusa*

Locality record : Taipei.

Genus ***Icerya*** Singoret 1875

Ann. Sco. Ent. France 5, 4 : 258. Type : *Coccus sacchari* Guercio-Meneville 1867 =*Dorthesia seychellarum* Westwood 1855.

Syn. : *Crossotosoma* Douglas 1890, *Procerya* Cockerell 1895, *Newsteadiella* MacGillivray 1921, *Newsteadia* MacGillivray 1921.

***I. aegyptica*** (Douglas 1890)

Ent. Mon. Mag. 26 : 79, *Crossotosoma* ; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8 : 101 ; Takahashi 1928 Philip. J. Sci. 36 : 329 ; 1929 Dept. Agr. Gov't. Res. Ints. Formosa Rept. 40 : 32.

Hosts : *Anona muricata, Artocarpus altilis, A. integrifolia, Celtis* sp., *Codiaeum variegatum, Ficus wightiana, Mallotus philippensis, Morus alba, Psidium gujava, Psychotria elliptica.*

Locality record : Shihlin, Chiayi, Kuantzeling, Tainan, Kaohsiung, Pingtung. Chihpen.

***I. purchasi*** Maskell 1878

Trans. N. Z. Inst. 11 : 221 ; Shiraki 1911 Rept. Stud. on *Icerya purchasi* ; 1913 Agr. Expt. St. Formosa Spec. Rept. 8 : 102 ; Takahashi 1928 Philip. J. Sci. 36 : 329.

Hosts : *Acacia confusa, Artemisia capillaris, Citrus* spp., *Rosa* sp., *Vitex*

*negundo*, *Casuarina equisetifolia*.

Locality record: Very common on the island.

***I. seychellarum*** (Westwood 1855)

Gard. Chron: 830, *Dorthesia*; Takahashi 1928 Philip. J. Sci. 36: 329; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40: 32; Shiraki 1913 Agr. Expt. Sta. Formosa Spec. Rept. 8: 103, *Icerya okadae*.

Syn.: *Icerya okadae* Kuwana 1907.

Hosts: *Areac catechu*, *Chrysophyllum caintio*, *Citrus* spp., *Eriobotrya japonica*, *Eugenia javanica*, *Ficus wightiana*, *Maba buxifolia*, *Mangifera indica*, *Machilus* sp., *Morus alba*, *Palaquium formosanum*, *Podocarpus macrophylla*, *Persea gratissima*, *Psidium gujava*, *Sapium sebiferum*, *Ternastremia japonica*.

Locality record: Taipei, Hsintien, Tungshih, Puli, Chiayi, Kuantzulineg, Tainan, Lanhsu.

### Genus ***Kuwanaia*** Lindinger 1953

Ztschr. der Wien. Ent. Gesell. 28: 221. Type: *Sasakia quercus* Kuwana 1902.

Syn.: *Sasakia* Kuwana 1902, *Kuwania* Cockerell 1903.

***K. quercus*** (Kuwana 1902)

Proc. Calif. Ac. Sci. 3, 3: 47, figs., 4, 8, *Sasakia*.

Host: *Cyclobalanopsis glauca*.

Locality record: Taiwan.

### Genus ***Lecaniodrosicha*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48: 29. Type: *Lecaniodrosicha lithocarpi* Takahashi 1930.

***L. lithocarpi*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48: 30.

Host: *Lithocarpus* sp.

Locality record: Erhshui.

## Family ORTHEZIDAE

### Genus ***Orthezia*** Bosc d'Antic 1784

Jour. de Phys. 24 (1): 171—173. Type: *Orthezia characias* Bosc d'Antic 1784 =*Aphis urticae* Linnaeus 1758.

Syn.: *Cyphoma* Gistel 1848, *Douglasiella* MacGillivray 1921, *Douglasia* Green 1902.

***O. yasushii*** Kuwana 1923

Imp. Plant Quar. Stat. Japan. Bull. 3: 58, fig.

Host: *Artemisia*.

Locality record: Kaohsiung.

## Family PSEUDOCOCCIDAE

### Genus ***Antonina*** Signoret 1879

Ann. Soc. Ent, France (Ser. 5) 5: 24; Kuwana 1932 Dobuts Zasshi Tokyo 44: 213—220, 2 figs; Ferris 1953 Atlas Scale Insects N. Amer. 6: 289. Type: *Antonia purpurea* Signoret 1872.

Syn.: *Laboulbenia* Lichtenstein 1877, *Serrolecanium* Shinji 1935.

***A. bambusae*** (Maskell 1892)

Trans. N. Z. Inst. 25: 237, *Sphaerococcus*; Ferris 1921 Bull. Ent. Soc. 12: 211; Takahashi 1928 Philip. J. Sci. 36: 339; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40: 45.

Host: Bamboo.

Locality record: Taipei, Peitau, Shihlin, Chushan, Puli, Chiayi, Kangshan.

***A. crawi*** Cockerell 1900

Psyche 9: 70; Takahashi 1928 Philip. J. Sci. 36: 338; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40: 44.

Syn.: *Antonina socialis* Newstead 1901.

Host: Bamboo.

Locality record: Taipei. .

***A. indica*** Green 1908

Mem. Dept. Agr. India Ent. Ser. 2 : 27 ; Takahashi 1928 Philip. J. Sci. 36 : 33 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 44.

Host : *Phragmites.*

Locality redord : Taipei.

Genus ***Dysmicoccus*** Ferris 1950

Atlas Scale Insects N. Amer. 5 : 53. Type : *Dactylopius brevipes* Cockerell 1893.

***D. boninsis*** (Kuwana 1909)

Jour. N. Y. Ent. Soc. 17 : 161—162 ; Ferris 1950 Atlas Scale Insects N. Amer. 5 : 57 ; *Dysmicoccus*

Host : *Saccharum officinarum.*

Locality record : Taiwan.

***D. brevipes*** (Cockerell 1893)

Entomologist 26 : 267, *Dactylopius* ; Takahashi 1928 Philip. J. Sci. 36 : 330, *Pseudococcus* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 34.

Host : *Ananas comosus.*

Locality record : Shilin, Chiayi, Kaohsung, Fengshan.

Genus ***Ferrisiana*** Takahahsi 1929

Trans. N. H. Soc. Formosa 19 : 429. Type : *Dactylopius virgatus* Cockerell 1893.

Syn. : *Ferrisia* Fullaway 1923.

***F. virgata*** (Cockerell 1893)

Entomologist 26 : 178, *Dactylopius virgatus* ; Ferris 1921 Bull. Ent. Res. 12 : 211, *Pseudococcus virgatus* ; Takahashi 1928 Philip. J. Sci. 36 : 335, *Ferrisia virgata* ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 39.

Syn. : *Dactylopius ceriferus* Newstead 1895, *D. talini* Green 1896, *Pseudococcus marchali* Vayssiere 1912, *P. bicaudatus* Keuchenis 1915, *P. dasylirii* Cockerell 1896.

Hosts : *Acalypha* sp., *Allophylus timorensis, Anona squamosa, Artocarpus integrifolia, Bauhinia* sp., *Bombax malapabricum, Calliandra haematocephala, Casuarina equisetifvlla, Citrus* spp., *Coffea arabica, Codiaeum veriegatung, Eugenia javanica, Euphoribia pulcherrima, Ficus retusa, Inocarpus doulis, Camellia japonica, Nerium odorum, Persea gratissima, Plumeria acutifolia, Psidium guyava, Panica grantum.*

Locality record : Taipei, Tungshih, Fengyuan, Changhua, Tainan, Kaohsiung, Henchun, Taitung, Hualen.

Genus ***Formicoccus*** Takahashi 1928

Trans. Nat. Hist. Soc. Formosa 18 : 253, fig. Type : *Formicoccus cinnamomi* Takahashi 1928.

***F. cinnamomi*** Takahashi 1928

Trans. Nat. Hist. Soc. Formosa 18 : 253, fig. ; Ferris 1955 Microentomology 20 : 4, figs.

Host : *Cinnamomum camphor.*

Locality record : Taipei, Hsintien, Peitau.

***F. schimae*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 40, figs.

Host : *Schima noranhae.*

Locality record : Shuishe.

Genus ***Heterococcus*** Ferris 1918

Standford Univ. Publ. Univer. Ser. 78 : 34, 65. Type : *Heterococcus arenae* Ferris 1918.

***H. pulverarius*** (Newstead 1892)

Ent. Mon. Mag. 28 : 145, *Ripersia pulveraria.*

Syn. : *Heterococcus graminicola* Morrison 1945, *H. variabilis* Schmutterer 1938, *Phenacoccus nudus* Green 1929.

Host : *Pleioblastus* sp.
Locality record : Nengkao, Meifeng.

Genus ***Kiritshenkella*** Borchsenius 1948

C. R. Acad. Sci. URSS (N. S. ) 63 : 583 ; 1960 Ent. Obozr. 39 : 937, 938. Type : *Kiristhenkellea stataria* Borchsnius 1948

***K. cellulosa*** (Hall 1923)

Minist Agr. Egypt Tech. Serv. Bull. 36 : 7, *Ripersia* ; Takahashi 1928 Philip. J. Sci. 36 : 333 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 40 ; Ezzat 1963 Bull. Soc. Ent. Egypt. 46 : 152, fig. redescription.

Syn. : *Trionymus miscanthi* Takahashi 1928 nec Cockerell 1903.

Hosts : *Bambusa, Miscanthus sinensis.*

Locality record : Taipei,

Genus ***Miscanthicoccus*** Takahashi 1957

Bull.. Univ. Osaka Pref. (B) 7 : 6, figs. Type : *Trionymus miscanthi* Takahashi 1928

***M. miscanthi*** (Takahashi 1928)

Philip. J. Sci. 36 : 333, fig., *Trionymus* ; 1957 Bull. Univ. Osaka Pref. (B) 7 : 6, figs., *Miscanthicoccus.*

Host : *Miscanthus* sp.

Locality record : Taipei.

Genus ***Neoripersia*** Kanda 1943

Kansai Ent. Soc. Trans. 12 : 49—50.

***N. miscanthicola*** (Takahashi 1937)

Mushi 9 : 70, *Trionymus* ; 1957 Bull. Univ. Osaka Pref. (B) 7 : 7 *Neoripersia.*

Host : *Miscanthus* sp.

Locality record : Taipei, Hsintien.

Genus ***Nipaecoccus*** Sulc 1945

Acta Soc. Sci. Nat. Norav. 17, 3 : 1, figs. Type : *Pseudococcus nipae* Maskell 1892.

Syn : *Elizaehtiella* Borchsenius 1947.

***N. filamentosus*** (Cockerell 1893)

Entomologist 26 : 268, *Pseudococcus* ; Ferris 1921 Bull. Ent. Res. 12 : 211 ; Takahashi 1928 Philip. J. Sci. 36 : 330 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 35.

Hosts : *Artocarpus integrifolia , Broussonetia pypyridera, Camellia chinensis, Carissa carandas, Citrus* spp., *Coffea arabica, Eugenia javanica, Ficus retusa, Gardenia florida, Musaenda luteola, Nerium odorum, Zizyphus* sp.

Locality record : Taipei, Ilan, Chiayi, Pingtung.

Genus ***Phenacoccus*** Cockerell 1893

Ent. News 4 : 318 ; Kanda 1935 Dobuts Zasshi 47 : 278 ; 1943 Trans. Kansai Ent. Soc. 12, 2 : 142-149 ; Ferris 1950 Atlas Scale Ins. N. Amer. 5 : 120. Type : *Pseudococcus aceri* Signoret 1875.

Syn. : *Paroudablis* Cockerell 1900, *Graminococcus* Kiritschenko 1940, *Penkinococcus* Sulc 1944, *Tetrura* Lichtenstein 1882.

***P. asteri*** Takahashi 1932

J. Soc. Trop. Agr. Formosa 4 : 43, figs.

Host : *Aster laurureanus.*

Locality record : Taipei.

***P. bambusae*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 6, figs.

Host : Bamboo.

Locality record : Shuishe, Chishan.

***P. fici*** Takahashi 1940

Mushi 13 : 21, figs.

Host : *Ficus* sp.

Locality record : Ouluanpi.

Genus ***Pilococcus*** Takahashi 1928

Trans. Nat. Hist. Soc. Formosa 18 : 257. Type : *Pilococcus miscanthi* Takahashi

1928.

***P. miscanthi*** Takahashi 1928

Trans. Nat. Hist. Soc. Formosa 18 : 257, figs., 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 40.

Hosts : *Miscanthus sinensis*, *M.* sp.

Locality record : Wulai, Hsintien, Chushan, Kenting.

Genus ***Planococcus*** Ferris 1950

Atlas Scale Insects N. Amer. 5 : 164. Type : *Dorthesia citri* (Risso 1813)

***P. citri*** (Risso 1813)

Essai Hist. Nat. Des Oranges, *Dorthesia* ; Ferris 1921 Bull. Ent. Res. 12 : 211, *Pseudococcus* ; Takahashi 1928 Philip. J. Sci. 36 : 329 ; 1929 Dept. Agr. . Gov't. Res. Inst. Formosa Rept. 40 : 33 ; Lin. 1972 Bur. Comm. Inspec. and Quar. Minist. Econ. Aff : 16.

Syn. : *Lecanium phyllococcus* Ashmead 1879, *Dactyolpius destructor* Comstock 1881, *Dactyolpius brevispinus* Targioni-Tozzetti 1881.

Hosts : *Acacia confusa*, *Amaryllis* sp., *Artocarpus altilis*, *A. integrifolia*, *Bryophyllum calycinum*, *Blumea balsamifera*, *Calathea tubispatha*, *Camellia chinensis*, *Carludovica palmata*, *Citrus* spp., *Clausena wampi*, *Codiaeum variegatume*, *Ixora chiennsis*, *Lespedeza* sp., *Michelia fuscata*, *Morus alba*, *Musa sp. Passiflora edulis*, *Persea gratissima*, *Physostegia virginia Tectona grandis*, *Tetrapanax papyrifera*.

Locality record : Taipei, Peitau, Puli, Chiayi, Hsinhua, Pingtung, Hunchun, Hualien, Taitung.

***P. kranuliae*** (Kuwana 1906)

Pap. Calif. Ac. Sci. 3 : 55, figs. 39, 40, *Dactylopius* ; Ferris 1950 Atlas Scale Insects. N. Amer 5 : 168, fig. *Planococcus*.

Hosts : Coffee, *Casuarina stricta*, *Artocarpus lanceolata*.

Locality record : Taipei, Kaohsiung, Pingtung.

***P. lilacinus*** (Cockerell 1905)

Proc. Davenport Acad. Sci. 10 : 128, *Pseudococcus* ; Takahashi 1928 Philip. J. Ser. 36 : 330 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 35.

Syn. : *Dactyolpius crotonis* Green 1905, *Tyolcoccus mauritiensis* Mamet 1939.

Hosts : *Acacia confusa*, *Anona reticulata*, *Areca oleracea*, *Artocarpus altilis*, *A. integrifolia*, *Bauhinia purparea*, *Callicarpa formosana*, *Citrus* spp., *Codiaeum variegatum*, *Erythrina* sp., *Eugenia jambos*, *E. javanica*, *Gardenia florida*, *Heritiera littoralis*, *Macaranga dipterocarpifolia*, *M.* sp., *Mallotus japonicus*, *M.* sp., *Rhododendron* sp., *Tamarindus indicus*, *Tectona grandis*, *Terminalia* sp.

Locality record : Taipei, Peitau, Hsintien, Taichung, Puli, Chiayi, Toko, Kenting, Hualien, Lanhsu.

Genus ***Pseudococcus*** Westwood 1840

Introd. Class. Insects 2 : 118 as *Pseudococcus* ; 445. Type : *Coccus aonidum* Linnaeus 1767=*longispinus* Targioni-Tozzetti 1868.

***P. aonidum*** Westwood 1839

Mon. Class. Insect. 1, symp. : 118 ; Takahashi 1928 Philip. J. Sci. 36 : 330 ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa, Rept. 40 : 34.

Syn. : *Pseudococcus longispinus* Targioni-Tozzetti 1862

Hosts. : *Areca catechu*, *Calophyllum inophyllum*, *Citrus* spp., *Ficus retusa*, *Gardenia florida*, *Helicio cochinchinensis*, *Magnolia* sp., *Prunus communis*, *Psidium guyava*.

Locality record : Tanshui, Taipei, Hsinhua, Yuechih, Pintung, Kenting.

***P. comstocki*** (Kuwana 1902)

Pap. Calif. Ac. 3, pl. 9, P : 52, figs. 34, 35, *Dactylopius* ; Ferris 1921 Bull. Ent. Res. 12 : 21 ; Lin. 1972 Bur. Comn. Insp. and Quar. Min. Econ. Aff. 6.

Hosts : *Pandanus* sp., *Ficus retusa*, *Psidium* sp, *Gardenia* sp, *Callophyllum inophyllum*, *Brusssonetia papyrifera*, *Citrus* spp. *Chrysalidocarpus lutescens Syzygium jambos*.

Locality record : Taipei, Peitau, Changhua, Chiayi, Kaohsiung, Hualien.

***P. bambusicola*** Takahashi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 1, fig.

Host : Bamboo.

Locality record : Erhshui.

***P. chipponensis*** Takahashi 1939

Mushi 12 : 86, fig.

Host. Citrus root.

Locality record : Chihpen.

***P. macarangae*** Takahashi 1940

Mushi 13 : 18, figs.

Hosts : *Macaranga tanarius*, *Mallotus* sp.

Locality record : Ouluanpi, Hualien.

***P. saccharicola*** Takahashi 1928

Philip. J. Sci. 36 : 331, fig. ; 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 34.

Host : *Saccharum officinarum*.

Locality record : Tainan.

***P. shintensis*** Takahashi 1934

Dept. Agr. Gov't. Res. Inst · Formosa Rept. 63 : 2.

Host : Graminae.

Locality record : Hsintien.

Genus ***Puto*** Signoret 1875

Ann. Soc. Ent. France 5, 5 : 394. Type : *Putonia antennata* Signoret 1875.

Syn. : *Putonia* Signoret 1875, *Ceroputo* Sulc 1898, *Macrocerococcus* Leonardi 1907.

***P. mangiferae*** (Green 1896)

Coccidae Ceylon : 393, pl. 164, *Phenacoccus* ; Takahashi 1929 Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 44, *Puto*.

Host : *Bladhia* sp.

Locality record : Shihlin.

Genus ***Ripersia*** Signoret 1875

Ann. Soc. Ent. France 5, 5 : 335. Type : *Ripersia corynephori* Signoret 1875.

Syn. : *Mizococcus* Takahashi 1928.

***R. takahashii*** Lindinger 1932

Konowia 11 : 203 n. n. for *sacchari* Takahashi 1928 ; Takahashi 1928 Philip. J. Sci. 36, fig. *Mizococcus sacchari*.

Syn. : *Mizocoscus sacchari* Takahashi 1928

Hosts : *Saccharum officinarum*, *Miscanthus* sp.

Locality record : Taichung, Pingtung.

Genus ***Saccharicoccus*** Ferris 1950

Atlas Scale Insects N. Amer. 5 : 21, 216. Type : *Dactylopius sacchari* Cokerell. 1895

***S. sacchari*** (Cockerell 1895)

J. Trin. Nat. Club 2 : 195, *Dactylopius*

Syn. : *Trionymus paregrandis* James 1936

Host : *Saccharum officinarum*.

Locality record : Taipei, Peitau, Taichung, Puli, Hsinhua, Hunchun, Hualien.

Genus ***Trionymus*** Berg 1899

Mus Nac. de Buenos Aires Comun. 1 : 178. Type : *Westwoodia perrisii* Signoret 1875.

Syn. : *Westwoodia* Signoret 1875, *Signoretia* Kratz 1888, *Volnicoccus* Goux 1945, *Bergrothiella* Rather 1898, *Bergro-*

*thula* Strand 1928.

***T. diminutus*** (Leonardi 1917)

Boll. Lab. Portici 12 : 198, figs., *Pseudococcus*

Hosts : *Miscanthus* sp., *Saccharum officinarum.*

Locality record : Miaoli, Puli, Taitung.

***T. formosanus*** Takahsshi 1930

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 48 : 4.

Host : Bambusa shoot sheath.

Locality record : Taipei, Chiayi.

***T. latus*** Takahashi 1929

Dept. Agr. Gov't. Res. Inst. Formosa Rept. 40 : 47.

Hosts : *Miscanthus sinensis, Schima.*

Locality record : Hsintien, Shuishe.

***T. taiwanus*** Takahashi 1932

J. Soc. Trop. Agr. Formosa 4 : 4, figs.

Hosts : *Oryza sativa, Ananas comosus.*

Locality record : Taipei, Lopei.

## Host Plant Index of Scale Insects of Taiwan, R. O. C.

Abies kawakamii (Pinaceae)
  Lepidosaphes nivalis Takagi 1970
Acacia confusa (Leguminosae)
  Coccus elongatus (Signoret 1873)
  Icerya purchasi (Maskell 1878)
  Planecoccus citri (Risso 1813)
  Planococcus lilacinus (Cockerell 1905)
Acalypha kotoensis (Euphorbiaceae)
  Chionaspis vitis (Green 1896)
Acalypha sp. (Euphorbiaceae)
  Ferrisiana virgata (Cockerell 1893)
Acer kawakamii (Aceraceae)
  Aulacaspis aceris Takahashi 1935
  Aulacaspis tubercularis Newstead 1906
Acer sp. (Aceraceae)
  Chionaspis sozanica Takahashi 1933
  Parlatoria crotonis Douglas 1887
Achras zapota (Sapotaceae) *
  Aspidiotus destructor Signoret 1869
  Coccus viridis (Green 1889)
Actinidia arisanensis (Actinidiaceae)
  Aulacaspis actinidae Takagi 1970
  Hemiberlesia rapax (Comstock 1881)
Actinodaphne mushaensis (Lauraceae)
  Aulacaspis actinodaphnes Takagi 1970
  Paracardicoccus actinodaphnis Takahashi 1935
Actinodaphne pedicellata (Lauraceae)
  Dinaspis taiwana Takahashi 1936
Actinodaphne sp. (Lauraceae)
  Aulacaspis yabunikkei Kuwana 1926
Adiantum sp. (Polypodiaceae)
  Saissitia hemisphaerica (Targioni-Tozzetti 1867)
Adinandra lasiostyla (Camelliaceae)
  Pinnaspis liui Takagi 1970
Adinandra millettii (Camelliaceae)
  Pinnaspis uniloba (Kuwana 1909)
Aegle marmelos (Rutaceae)
  Coccus viridis (Green 1889)
Aegle sepiaria (Rutaceae)
  Saissetia formicarii (Green 1896)
Agave rigida (Amaryllidaceae)
  Coccus hesperidum Linnaeus 1758
Agave sp. (Amaryllidaceae)
  Coccus hesperidum Linnaeus 1758
Aglaia formosana (Meliaceae)
  Eucalymnatus tessellatus (Signoret 1873)
Aglaia odorata (Meliaceae)
  Saissetia formicarii (Green 1896)
Allophylus timorensis (Sapindaceae)
  Ferrisiana virgata (Cockerell 1893)
Ananas comosus (Bromeliaceae) *
  Diaspis bromeliae (Kennicott 1778)
  Dysmicoccus brevipes (Cockerell 1893)
  Trionymus taiwanus Takahashi 1932
Annona montana (Annonaceae) *

*exotic plant species.

Coccus elongatus (Signoret 1873)
Icerya aegyptica (Douglas 1890)

Annona reticulata (Annonaceae) *
Planococcus lilacinus (Cockerell 1905)

Annona sp. (Annonaceae) *
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Annona squamosa (Annonaceae) *
Aspidiotus destructer Signoret 1869
Coccus elongatus (Signoret 1873)
Ferrisiana virgata (Cockerell 1893)

Ardisia crispa (Myrsinaceae)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Ardisia japonica (Myrsinaceae)
Aonidiella aurantii (Maskell 1878)

Ardisia quinquegona (Myrsinaceae)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Saissetia nigra (Nietner 1861)

Ardisia sieboldii (Bladhia) (Myrsinaceae)
Aonidiella citrina (Coquillett 1891)
Aonidiella messengeri McKenzie 1953
Aulacaspis robusta Takahashi 1931
Hemiberlesia lataniae (Signoret 1869)
Parainsulaspis bladhiae (Takahashi 1931)
Saissetia formicarii (Green 1896)
Tachardina theae Green and Mann 1907

Ardisia sp. (Bladhia) (Myrsinaceae)
Coccus acuminatus (Signoret 1873)
Parainsulaspis kamakurensis (Kuwana 1925)
Pseudococcus mangiferae (Green 1896 )

Areca catechu (Palmae) *
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Icerya seychellarum (Westwood 1855)
Pseudococcus aonidum (Westwood 1839 )
Saissetia nigra (Nietner 1861)

Areca oleracea (Palmae)
Coccus hespersidum Linnaeus 1758
Planococcus lilacinus (Cockerell 1905
Saissetia formicarii (Green 1896)

Arenga engleri (Palmae)
Fiorinia arengae Takahashi 1934
Fiorinia taiwana Takahashi 1934
Parlatoria arengae Takagi 1969

Artabotrys uncinatus (Anonaceae)
Chrysomphalus ficus Ashmead 1880

Artemisia capillaris (Compositae)
Ceroplastes ceriferens (Anderson 1791 )
Icerya purchasi (Maskell 1878)
Saissetia nigra (Nietner 1861)

Artemisia sp. (Compositae)
Orthezia yasushii Kuwana 1923

Artocarpus altilis (Moraceae)
Icerya aegyptica (Douglas 1890)
Planococcus citri (Risso 1813)
Planococcus lilacinus (Cockerell 1905)

Artocarpus integrifolia (Moraceae)
Coccus acutissimus (Green 1896)
Ferrisiana virgata (Cockerell 1893)
Icerya aegyptica (Douglas 1890)
Nipaecoccus filamentosus (Cockerell 1893)
Planococcus citri (Risso 1813)
Planococcus lilacinus (Cockecell 1905)
Pseudaonidia trilobitiformis (Green 1896)
Pulvinaria psidii Maskell 1892
Saissetia formicarii (Green 1896)

Artocarpus sp. (Moraceae)
Ceroplastes floridensis Comstock 1881

Arundo formosana (Bambusaceae)
Duplachionaspis divergens (Green 1899 )
Nikkoaspis hichiseiana (Takahashi 1934)

Aspidistra lurida (Liliaceae)
Pinnaspis aspidistrae (Signoret 1869)
Asplenium nidus (Polypodiaceae)
Pinnaspis aspidistrae (Signoret 1869)
Aster laurureanus (Compositae)
Phenacoccus asteri Takahashi 1932
Averrhoa carambola (Oxalidaceae)
Laccifer greeni (Chamberlin 1923)
Bamboo (Bambusaceae)
Acanthomytilus vermiformis (Takahashi 1930)
Antonina bambusae (Maskell 1892)
Antonina crawi Cockerell 1900
Asterolecanium miliaris var. rubsutum Green 1908
Asterolecanium pseudomilliaris Green 1922
Eriococcus transversus Green 1922
Formosaspis formosanus (Takahashi 1931)
Formosaspis takahashii Lindinger 1932
Greenaspis bambusifoliae (Takahashi 1930)
Greenaspis elongata (Green 1899)
Kuwanaspis bambusifoliae (Takahashi 1934)
Kuwanaspis elongata (Takahashi 1930 )
Kuwanaspis formosana (Takahashi 1930)
Kuwanaspis neolinearis (Takahashi 1930)
Kuwanaspis pasudoleucaspis (Kuwana 1902)
Mixaspis babmusicola (Takahashi 1930)
Phenacoccus babmusae Takahashi 1930
Poliaspoides formosana (Takahashi 1930)
Pseudococcus bambusicola Takahashi 1930
Bambusa sp. (Bambusaceae)
Asterolecanium bambusae (Boisduvoal 1869)
Asterolecanium bambusicola Kuwana 1916
Asterelecanium pseudolanceolatum Takahashi 1933
Kiritshenkella cellulosa (Hall 1923)
Trionymus formosanus Takahashi 1930
Bambusa oldhamii (Bambusaceae)
Kuwanaspis vermiformis (Tahahashi 1931)
Bambusa stenostachya (Bambusaceae)
Asterolecanium bambusae (Boisduval 1869)
Asteroecanium coronatum Green 1909
Asterolecanium minutum Takahashi 1930
Kuwanaspis amandalei (Green 1919)
Kuwanaspis vermiformis (Takahashi 1931)
Odonaspis pencillata Green 1905
Odonaspis secreta (Cockerell 1890)
Bauhinia alba (Caesaldpiniaceae)
Coccus hesperidum Linnaeus 1758
Bauhinia purpurea (Caesalpiniaceae)
Planococcus lilacinus (Cockerell 1905)
Bauhinia sp. (Caesalpiniaceae)
Ferrisiana virgata (Cockerell 1893)
Beilschmiedia erythrophloria (Lauraceae)
Aspidiotus destructor Signoret 1869
Bischofia javanica (Euphorbiaceae)
Pseudaulacaspis cockerelli (Cooley 1897)
Saissetia formicarii (Green 1896)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Saissetia nigra (Nietner 1861)
Blumea balsamifera (Compositae)
Planococcus citri (Risso 1813)
Bobua arisanensis (Symplocaceae)
Saissetia bobuae Takahashi 1935
Boehmeria densiflora (Urticaceae)
Parlatoria fluggeae Hall 1929

Pinnaspis hibisci Takagi 1970
Boehmeria sp. (Urticaceae)
Pulvinaria maxima Green 1904
Bombax malabaricum (Bombacaceae)
Ferrisiana virgata (Cockerell 1893)
Bridelia sp. (Euphorbiaceae)
Pseudaulacaspis brideliae (Takahashi 1933)
Broussonetia papyrifera (Moraceae)
Nipaecoccus filamentosus (Cockerell 1893)
Bryophyllum calycinum (Crassulaceae)
Lindingaspis rossi (Maskell 1890)
Planococcus citri (Risso 1813)
Buchanania arborescens (Anacardiaceae)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Buxus japonicus (Buxaceae)
Chrysomphalus ficus Ashmead 1880
Cajanus cajan (Leguminosae)
Laccifer lacca (Kerr 1982)
Calanthe sp. (Orchidaceae)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Calathea tubispatha (Marantaceae) *
Planococcus citri (Risso 1813)
Calliandra haematocephala (Leguminosae)
Coccus elongatus (Signoret 1873)
Ferrisiana virgata (Cockerell 1893)
Laccifer greeni (Chamberlin 1923)
Callicarpa formosana (Verbenaceae)
Coccus hesperidum Linnaeus 1758
Planococcus lilacinus (Cockerell 1905)
Saissetia formicarii (Green 1896)
Calophyllum inophyllum (Guttiferae)
Ceroplastes floridensis Comstock 1881
Ceroplastes rubens Maskell 1892
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Coccus hesperidum Linnaeus 1758
Eucalymnatus tessellatus (Signoret 1873)
Lindingaspis ferrisi McKenzie 1950
Lindingaspis rossi (Maskell 1890)
Parlatorias camelliae Comstock 1883
Pseudaonidia trilobitiformis (Green 1896)
Pseudococcus aonidum (Westwood 1839 )
Pseudococcus comstocki (Kuwana 1902 )
Saissetia nigra (Nietner 1861)
Saissetia oleae (Bernard 1782)
Camellia chinensis (sinensis) (Camelliaceae)
Aspidiotus destructor Signoret 1869
Cerococcus ficoides Green 1899
Ceroplastes ceriferens (Anderson 1791 )
Ceroplastes floridensis Comstock 1881
Chrysomphalus ficus Ashmead 1880
Eriochiton theae Green 1900
Hemiberlesia cyanophylli (Signoret 1869)
Nipaecoccus filamentosus (Cockerell 1893)
Pinnaspis aspidistrae (Signoret 1869)
Pinnaspis theae (Maskell 1891)
Planococcus citri (Risso 1813)
Saissetia formicarii (Green 1896)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Selanomphalus euryae (Takahashi 1931 )
Tachardina theae Green and Mann 1907
Camellia japonica (Camelliaceae)
Aspidiotus destructor Signoret 1869
Coccus hesperidum Linnaeus 1758
Chrysomphalus ficus Ashmead 1880
Ferrisiana virgata (Cockerell 1893)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Hemiberlesia cyanophylli (Signoret

1869)
Parlatoria pergandei Comstock 1881
Pinnaspis uniloba (Kuwana 1909)
Pinnaspis theae (Maskell 1891)
Pseudaonidia trilobitiformis (Green 1896)
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Fiorinia minor Maskell 1897
Parlatoria mytilaspiformis Green 1899
Pseudaulacaspis cockerelli (Cooley 1897)

Carica papaya (Caricaceae) *
Aonidiella inornata McKenzie 1938
Aspidiotus destructor Signoret 1869
Coccus elongatus (Signoret 1873)
Coccus hesperidum Linnaeus 1758

Carissa carandas (Apocynaceae)
Chrysomphalus ficus Ashmead 1880

Carissa caranduas (Apocynaceae) *
Ceroplastes floridensis Comstock 1881
Coccus viridis (Green 1889)
Lepidosaphes gloveri (Packard 1869)
Nipaecoccus filamentosus (Cockerell 1893)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Carludovica palmata (Cyclanthaceae) *
Planococcus citri (Risso 1813)

Castanopsis kusanoi (Fagaceae)
Andaspis crawii (Cockerell 1896)
Afiorinia hirashimai Takagi 1970
Neoparlatoria miyamotoi Takagi 1969

Castanopsis sp. (Fagaceae)
Neoparlatoria lithocarpicola Takahashi 1931
Neoparlatoria maai Takagi 1969

Casuarina equisetifolia (Casuarinaceae) *
Coccus elongatus (Signoret 1873)
Ferrisiana virgata (Cockerell 1893)
Icerya purchasi (Maskell 1878)

Cannna indica (Cannaceae)
Saissetia nigra (Nietner 1861)

Celtis sinensis (chinensis) (Ulmaceae)
Fiorinia minor Maskell 1897
Hemiberlesia cyanophylli (Signoret 1869)
Lepidosaphes takaoensis Takahashi 1935

Celtis sp. (Ulmaceae)
Icerya aegyptica (Douglas 1890)

Chamaecyparis formosensis (Cupressaceae)
Lepidosaphes yoshimotoi Takagi 1970

Chrysalidocarpus lutescens (Palmae) *
Aspidiotus destructor Signoret 1869
Fiorinia taiwana Takahashi 1934
Parlatoria proteus (Curtis 1843)

Chrysophyllum cainito (Saptoaceae)
Icerya seychellarum (Westwood 1855)
Pulvinaria psidii Maskell 1892
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Saissetia nigra (Nietner 1861)

Cinchona sp. (Rubiaceae) *
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Cinnamomum camphor (Lauraceae)
Aulacaspis yabunikkei Kuwana 1926
Chrysomphalus ficus Ashmead 1880
Formicoccus cinnamomi Takahashi 1928
Saissetia formicarii (Green 1896)

Cinnamomum erythrophloria (Beilschmidia) (Laruaceae)
Chionaspis machilicola (Takahashi 1935) var. cinnamomicola Takahashi 1935

Cinnamomum kanehirai (Lauraceae)
Eucornuaspis machili (Maskell 1898)

Cinnamomum reticulatum (Lauraceae)
Aulacaspis greeni Takahashi 1934

Cinnamomum sp. (Lauraceae)
Aspidiotus destructor Signoret 1869

Aonidia tentaculata Green var. formosana Takahashi 1935
Aulacaspis greeni Takahashi 1934
Chionaspis machili (Takahashi 1931)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Neoplatylecanium cinnamomi Takahashi 1929
Paralecaninum machili Takahashi 1933

Cinnamomum zeylanicum (Lauraceae) *
Ceroplastes rubens Maskell 1892
Eucalymnatus tessellatus (Signoret 1873)
Saissetia formicarii (Green 1896)
Silvestraspis uberifera (Lindinger 1911)

Citrus spp. (Rutaceae)
Aonidiella aurantii (Maskell 1878)
Aonidiella citrina (Coquillett 1891)
Aspidiotus destructor Signoret 1869
Ceroplastes ceriferens (Anderson 1791)
Ceroplastes floridensis Comstock 1881
Ceroplastes rubens Maskell 1892
Chrysomphalus dictyospermi (Morgan 1889)
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Coccus hesperidum Linnaeus 1758
Coccus mangiferae (Green 1889)
Coccus viridis (Green 1889)
Ferrisiana virgata (Cockerell 1893)
Fiorinia proboscidaria Green 1900
Fiorinia theae Green 1900
Icerya purchasi Maskell 1878
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Lepidosaphes beckii (Newman 1869)
Lepidosaphes gloveri (Packard 1869)
Lindingaspis ferrisi McKenzie 1950
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Parlatoria pergandei Comstock 1881
Parlatoria proteus (Curtis 1843)
Parlatoria zizyphi Lucas 1853
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Pseudaonidia trilobitiformis (Green 1896)
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Pseudococcus chipponensis Takahashi 1939
Pseudococcus comstocki (Kuwana 1902)
Pulvinaria polygonata Cockerell 1905
Pulvinaria psidii Maskell 1892
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
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Clausena lunulata (Rutaceae)
Coccus viridis (Green 1889)

Clausena wampi (Rutaceae)
Planococcus citri (Risso 1813)

Clerodendrun inerme (Verbenaceae)
Aspidiotus excisus Green 1896

Cleyera japonica var. morii (Camelliaceae)
Aonidiella citrina (Coquillett 1891)
Pinnaspis uniloba (Kuwana 1909)

Cleryera japonica var. japonica (Camelliaceae)
Chrysomphalus ficus Ashmead 1880
Pinnaspis uniloba (Kuwana 1909)

Cocos nucifera (Palmae) *
Aspidiotus destructor Signoret 1869
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Coccus hesperidum Linnaeus 1758
Eucalymnatus tessellatus (Signoret 1873)
Hemiberlesia cyanophylli (Signoret 1869)
Hemiberlesia lataniae (Signoret 1869)

Lindingaspis rossi (Maskell 1890)

Codiaeum variegatum (Euphorbiaceae)
Coccus elongatus (Signoret 1873)
Ferrisiana virgata (Cockerell 1893)
Icerya aegyptica (Douglas 1890)
Lepidosaphes beckii (Newman 1869)
Lepidosaphes takaoensis Takahashi 1935
Lepidosaphes tokionis (Kuwana 1902)
Planococcus lilacinus (Cockerell 1905)
Saissetia nigra (Nietner 1861)

Coffea arabica (Rubiaceae) *
Coccus viridis (Green 1889)
Ferrisiana virgata (Cockerell 1893)
Nipaecoccus filamentosus (Cockerell 1893)
Planococcus citri (Risso 1813)
Pulvinaria psidii Maskell 1892
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Crotalaria (Leuguminosae)
Pseudaulacaspis pentagona (Targioni-Tozzetti 1855)

Cryptomeria japonica (Taxodiaceae)
Aspidiotus cryptomeriae Kuwana 1902

Cucurbita moschata (Cucurbitaceae) *
Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Cudrania cochinchinensis (Moraceae)
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Cupressus juniperinus (Cupressaceae)
Fiorinia pinicola Maskell 1897

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Lepidosaphes cycadicola Kuwana 1931
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Cycas sp. (Cycadaceae)
Aonidiella inornata McKenzie 1938
Chrysomphalus bifasciculatus Ferris 1938

Cyclobalanopsis glauca (Fagaceae)
Asterolecanium passaniae Kuwana and Cockerell 1909
Fiorinia taiwana Takahashi 1934
Kuwanaia quercus (Kuwana 1902)
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Cymbidium gyokuchin (Orchidaceae)
Aspidiotus destructor Signoret 1869

Cymbidium sinensis (Orchidaceae)
Hemiberlesia lataniae (Signoret 1869)
Parlatoria pergandei Comstock 1881
Parlatoria proteus (Curtis 1843)

Decaspermum fruticosum (Myrtaceae)
Fiorinia fioriniae (Targioni-Tozzetti 1867)

Dendrocalamus latiflorus (Bambusaceae)
Kuwanaspis vermiformis (Takahashi 1931)
Odonaspis pencillata Green 1905

Dendrobium moschatum (Orchidaceae)
Parlatoria crotonis Douglas 1887

Derris laxiflora (Leguminosae)
Coccus elongatus (Signoret 1873)

Dianellia ensifolia (Liliaceae)
Chrysomphalus bifaciculatus Ferris 1938

Diospyros discolor (Ebenaceae)
Aspidiotus destructor Signoret 1869
Ceroplastes floridensis Comstock 1881
Diaspis manni (Green 1906)
Hemiberlesia lataniae (Signoret 1869)
Pseudaulacaspis takahashii (Ferris 1955)

Saissetia formicarii (Green 1896)
Saissetia hemisphaerica (Tartioni-Tozzetti 1867)
Diospyros eriantha (Ebenaceae)
Lindingaspis rossi (Maskell 1890)
Diospyros kaki (Ebenaceae)
Saissetia formicarii (Green 1896)
Duranta repens (Verbenaceae) *
Pulvinaria durantae Takahashi 1931
Eleaegnus glabra (Elaeaganaceae)
Chionaspis vitis (Green 1896)
Elaeagnus lotoensis (Elaegaenaceae) = Elaeagnus macrophylla
Chionaspis vitis (Green 1896)
Elaeagnus sp. (Elaeagnaceae)
Aulacaspis difficilis (Cockerell 1896)
Elaeagnus thunbergii (Elaeagnaceae)
Chionaspis vitis (Green 1896)
Elaeocarpus elliptica (Elaeocarpaceae)
Protopulvinaria pyriformis (Cockerell 1894)
Elephantopus mollis (Compositae)
Aspidiotus excisus Green 1896
Ehretia sp. (Borraginaceae)
Coccus hesperidum Linnaeus 1758
Eriobotrya japonica (Rosaceae)
Ceroplastes floridensis Comstock 1881
Coccus hesperidum Linnaeus 1758
Icerya seychellarum (Westwood 1855)
Erythrina sp. (Papilionaceae)
Lepidosaphes tubulorum Ferris 1921
Planococcus lilacinus (Cockerell 1905)
Erythroxylum coca var. spruceanum (Erythroxylaceae)
Coccus elongatus (Signoret 1873)
Eucalyptus sp. (Myrtaceae) *
Saissetia formicarii (Green 1896)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Eugenia jambos (Myrtaceae) *
Ceroplastes rubens Maskell 1892
Coccus acutissimus (Green 1896)
Saissetia armataTakahashi 1930
Planococcus lilacinus (Cockerell 1905)
Eugenia javanica (Myrtaceae) *
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Fiorinia proboscidaria Green 1900
Fiorinia theae Green 1900
Ferrisiana virgata (Cockerell 1893)
Icerya seychellarum (Westwood 1855)
Nipaecoccus filamentosus (Cockerell 1893)
Planococcus lilacinus (Cockerell 1905)
Saissetia formicarii (Green 1896)
Saissetia nigra (Nietner (1861)
Eugenia sp. (Myrtaceae) *
Decoraspis lahoarei (Takahashi 1931)
Eugenia uniflora (Myrtaceae) *
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Euonymus echinatus (Celastraceae)
Unaspis aei Takagi 1970
Euphoria longana (Sapindaceae) *
Ceroplastes rubens Maskell 1892
Coccus acutissimus (Green 1896)
Coccus hesperidum Linnaeus 1758
Eucalymnatus tessellatus (Signoret 1873)
Laccifer greeni (Chamberlin 1923)
Pulvinaria psidii Maskell 1892
Saissetia oleae (Bernard 1782)
Thysanofiorinia nephalii (Maskell 1898 )
Euphorbia pulcherrima (Epuhorbiaceae)
Ferrisiana virgata (Cockerell 1893)
Eurya acuminata (Camelliaceae)
Pinnaspis liui Takagi 1970
Pseudaulacaspis cockerelli (Cooley 1897 )
Pseudaulacaspis megacauda Takagi 1970
Eurya crenatifolia (Camelliaceae)
Lopholeucaspis japonica (Cockerell

1897)
Pseudaulacaspis cockerelli (Cooley 1897 )

Eurya japonica (Camelliaceae)
Achionaspis kanoi Takagi 1970
Pinnaspis aspidistrae (Signoret 1869)
Pinnaspis frontalis Takagi 1970
Pinnaspis uniloba (Kuwana 1909)
Pseudaulacaspis cockerelli (Cooley 1897)

Eurya strigillosa (Camelliaceae)
Pinnaspis liui Takagi 1970
Pseudaulacaspis cockerelli (Cooley 1897 )

Eurya sp. (Camelliaceae)
Fiorinia vaccini Kuwana var. hisakakii Takahashi 1936
Metaspidiotus stauntoniae (Takahashi 1933)
Parlatoria pergandei Comstock 1881
Selanomphalus euryae (Takahsahi 1931 )

Evodia merrillii=Melicope confusa=roxburghiana (Rutaceae)
Chrysomphalus ficus Ashmead 1880
Pulvinaria neocellulosa Takahashi 1940

Evodia triphylla=Melicope awadan (Rutaceae)
Saissetia formicarii (Green 1896)

Excoecaria orientalis (Euphorbiaceae)
Pseudaulacaspis cockerelli (Cooley 1897 )

Fagraea sp. (Potaliaceae)
Aulacaspis fagraeae (Green 1896)

Ficus beecheyana (Moraceae)
Aspidiotus destructor Signoret 1869
Pseudaulacaspis major (Cockerell 1894 )

Ficus carica (Moraceae) *
Saissetia nigra (Nietner 1861)

Ficus cuspidatocaudata (Moraceae)
Parlatoria camelliae Comstock 1883
Pinnaspis shirozui Takagi 1970

Ficus elastica (Moraceae) *
Eucalymnatus tessellatus (Signoret 1873)
Pseudaonidia trilobitiformis (Green 1896)
Saissetia nigra (Nietner 1861)

Ficus foveolata (Moraceae)
Fiorinia formosensis Takahashi 1983
Ichthyaspis ficicola (Takahashi 1931)
Metaspidiotus stauntoniae (Takahashi 1933)
Parlatoria pergandei Comstock 1881

Ficus gibbosa (Moraceae)
Saissetia nigra (Nietner 1861)

Ficus leucantatoma (Moraceae)
Saissetia formicarii (Green 1896)

Ficus nervosa (Moraceae)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Ungulaspis ficicola (Takahashi 1932)

Ficus pumila (Moraceae)
Lindingaspis rossi (Maskell 1890)
Pseudaonidia trilobitiformis (Green 1896)

Ficus retusa=microcarpa (Moraceae)
Ceroplastes ceriferens (Anderson 1791 )
Ceroplastodes chiton Green 1909
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Drosicha maskelli Cockerell 1902
Ferrisiana virgata (Cockerell 1893)
Nipaecoccus filamentosus (Cockerell 1893)
Paralecanium expansum (Green 1896)
Parlatoria pergandei Comstock 1881
Pseudanoidia trilobitiformis (Green 1896)
Pseudococcus aonidum (Westwood 1839 )
Pseudococcus comstocki (Kuwana 1902

)

Saissetia nigra (Nietner 1861)

Tachardina theae Green and Mann 1907

Ficus sp. (Moraceae)

Aspidiotus destructor Signoret 1869

Cerococcus ficoides Green 1899

Fiorinia formosensis Takahashi 1983

Fiorinia minor Maskell 1897

Ichthyaspis ficicola (Takahashi 1931)

Laccifer lacca (Kerr 1782)

Metaspidiotus stauntoniae (Takahashi 1933)

Saissetia formicarii (Green 1896)

Saissetia nigra (Nietner 1861)

Phenacoccus fici Takahashi 1940

Ficus swinhoei (Moraceae)

Pinnaspis muntingi Takagi 1965

Pseudaonidia trilobitiformis (Green 1896)

Ficus vasculosa (Moraceae)

Saissetia formicarii (Green 1896)

Ficus wightiana (Moraceae)

Icerya aegyptica (Douglas 1890)

Icerya seychellarum (Westwood 1855)

Laccifer greeni (Chamberlin 1923)

Saissetia formicarii (Green 1896)

Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Saissetia nigra (Nietner 1861)

Flacourtia ramontchii (Flacourtiaceae)

Pseudaulacaspis major (Cockerell 1894 )

Garcinia spicata (Guttiferae)

Ceroplastes rubens Maskell 1892

Chrysomphalus ficus Arhmead 1880

Hemiberlesia lataniae (Signoret 1869)

Saissetia formicarii (Green 1896)

Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Vinsonia stellifera (Westwood 1871)

Gardenia florida (Rubiaceae)

Coccus acuminatus (Signoret 1873)

Coccus hesperidum Linnaeus 1758

Coccus viridis (Green 1889)

Cerococcus ficoides Green 1899

Ceroplastes floridensis Comstock 1881

Nipaecoccus filamentosus (Cockerell 1893)

Planococcus lilacinus (Cockerell 1905)

Pseudococcus aonidum (Westwood 1839 )

Pulvinaria psidii Maskell 1892

Saissetia formicarii (Green 1896)

Saissetia hemisphaerica (Targioni-Tozzetti 1867)

Saissetia oleae (Bernard 1782)

Gardenia sp. (Rubiaceae)

Hemiberlesia cyanophylli (Signoret 1869)

Pseudococcus comstocki (Kuwana 1902)

Genipa americana (Rubiaceae)

Coccus viridis (Green 1889)

Glochidion callicarpa (Euphorbiaceae)

Coccus elongatus (Signoret 1873)

Glochidion dasyphyllum (Euphorbiaceae)

Saissetia armata Takahashi 1930

Glochidon eriocarpum (Euphorbiaceae)

Coccus hesperidum Linnaeus 1758

Glochidion hongkongense (Euphorbiaceae)

Aspidiotus excisus Green 1896

Glochidon sp. (Euphorbiaceae)

Anomalococcus multipori Morrison 1921

Coccus hesperidum Linnaeus 1758

Eriochiton formosae Takahashi 1929

Pulvinaria maxima Green 1904

Saissetia nigra (Nietner 1861)

Goniothalamus longifolia (Anonaceae)

Coccus elongatus (Signoret 1873)

Gordonia axillaris (Camelliaceae)

Diaspis manni (Green 1906)

Parlatoria camelliae Comstock 1883

Saissetia formicarii (Green 1896)
Selanomphalus euryae (Takahashi 1931
)
Gossypium herbaceum (Malvaceae)
Saissetia nigra (Nietner 1861)
Saissetia oleae (Bernard 1783)
Grass=Gramineae.
Acanthomytilus graminicola (Takahashi 1934)
Chortinaspis bilobis (Maskell 1898)
Pseudococcus shintensis Takahashi 1934
Grevillea robusta (Proteaceae) *
Saissetia formicarii (Green 1896)
Helicia cochinchinensis (Proteaceae)
Pseudococcus aonidum (Westwood 1839
)
Helicia formosana (Proteaceae)
Aonidiella citrina (Coquillett 1891)
Heritiera littoralis (Sterculiaceae)
Coccus viridis (Green 1889)
Eucalymnatus tessellatus (Signoret 1873)
Laccifer greeni (Chamberlin 1923)
Planococcus lilacinus (Cockerell 1905)
Heterosmilax japonica (Smilacaceae)
Parainsulaspis kamakurensis (Kuwana 1925)
Hibiscus rosasinensis (Malvaceae)
Aspidiotus destructor Signoret 1869
Coccus elongatus (Signoret 1873)
Hemiberlesia lataniae (Signoret 1869)
Laccifer lacca (Kerr 1782)
Neopinnaspis harperi McKenzie 1949
Pinnaspis hibisci Takagi 1970
Hibiscus taiwanensis (Malvaceae)
Pinnaspis hibisci Takagi 1970
Hibiscus tiliaceus (Malvaceae)
Aulacaspis crawii (Cockerell 1898)
Metaspidiotus stauntoniae (Takahashi 1933)
Parlatoreopsis chinensis (Marlatt 1908
)
Hoya carnosa (Asclepiadaceae)
Aspidiotus excisus Green 1896
Hydrangea integrifolia (=integra) (Hydrangeaceae)
Lopholeucaspis japonica (Cockerell 1897
)
Pseudaonidia trilobitiformis (Green 1896)
Hydrangea sp. (Saxifragaceae)
Lopholeucaspis japonica (Cockerell 1897)
Ilex formosana (Aquifoliaceae)
Lepidosaphes leei Takagi 1970
Ilex sp. (Aquifaliaceae)
Hemiberlesia rapax (Comstock 1881)
Illicium philippinense (Winteraceae)
Parlatoria crotonis Douglas 1887
Imperata arundenacea (Gramineae)
Acanthomytilus imperatae (Kuwana 1931)
Inocarpus edulis (Leguminosae)
Ferrisiana virgata (Cockerell 1893)
Ixora chinensis (Rubiaceae) *
Ceroplastes ceriferens (Anderson 1791
)
Coccus viridis (Green 1889)
Planococcus citri (Risso 1813)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Juniperus sp. (Cupressaceae)
Hemiberlesia lataniae (Signoret 1869)
Lepidosaphes maskelli (Cockerell 1897
)
Kandelia rheedii (Rhizophoraceae)
Chinonaspis vitis (Green 1896)
Lindingaspis rossi (Maskell 1890)
Lepidosaphes pullida (Green 1896)
Parainsulaspis glaucae (Takahashi 1932)
Kentia macarthurii (Palmae) *
Saissetia formicarii (Green 1896)

Keteteeria davidiana (Pinaceae)
Fiorinia japonica Kuwana 1902
Lacuma nervosa ( )
Howardia biclavis (Comstock 1883)
Lagerstroemia flosreginae (Lythraceae)
Saissetia formicarii (Green 1896)
Lagerstroemia indica (Lythraceae)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Lespedeza sp. (Leguminosae)
Planococcus citri (Risso 1813)
Ligustrum japonicum (Oleaceae)
Aspidiotus destcuctor Signoret 1869
Chysomphalus ficus Ashmead 1880
liliaceous plant
Parlatoria virescens Maskell 1897
Lindera communis (Lauraceae)
Chionaspis uenoi Takagi 1970
Fiorinia linderae Takagi 1970
Fiorinia smilaceti Takahashi 1931
Lindera sp. (Lauraceae)
Aulacaspis yabunikkei Kuwana 1926
Liquidamba formosana (Hamanelidaceae)
Laccifer greeni (Chamberlin 1923)
Lopholeucaspis japonica (Cockerell 1897)
Pseudaulacaspis cockerelli (Cooley 1897)
Listea akoensis (Lauraceae)
Hemiberlesia lataniae (Signoret 1869)
Megacanthaspis litseae Takagi 1970
Thysanaspis perkinsi Takagi 1969
Lithocarpus sp. (Fagaceae)
Asterolecanium horishae Russell 1941
Diaspis manni (Green 1906)
Kuwanaia lithocarpi Takahashi 1930
Lecanodiaspis cremastogastri Takahashi 1929
Lepidosaphes lithocarpi Takahashi 1934
Neoparlatoria formosana Takahashi 1931
Parlatoria lithocarpi Takahashi 1935
Pinnaspis lithocarpi Takahashi 1931
Quernaspis lithocarpi (Takahashi 1931 )
Saissetia formicarii (Green 1896)
Lithocarpus uraiana (Fagaceae)
Andaspis crawii (Cockerell 1896)
Asterolecanium pasaniae Kuwana and Cockerell 1909
Neoparlatoria lithocarpi Takahashi 1934
Neoparlatoria lithocarpicola Takahashi 1931
Livistona subglosa (Palmae)
Aonidiella citrina (Coquillett 1891)
Lonicera japonica var. sempervillods (Caprifoliaceae)
Aspidiotus destructor Signoret 1869
Loranthus parasiticus (Loranthaceae)
Selanomphalus euryae (Takahashi 1931 )
Maba buxifolia (Ebenaceae)
Icerya seychellarum (Westwood 1885)
Macaranga dipterocarpifolia (Euphoriaceae)
Planococcus lilacinus (Cockerell 1905)
Macaranga sp. (Euphorbiaceae)
Planococcus lilacinus (Cockerell 1905)
Macaranga tanarius (Euphorbiaceae)
Pseudococcus macarange Takahashi 1940
Machilus japonica (Luraceae)
Chionaspis machili (Takahashi 1931)
Chionaspis schizosoma Takagi 1970
Leucaspis incisa Takagi 1969
Leucaspis machili Takagi 1969
Parlatoria machili Takahashi 1931
Machilus kusanoi (Luraceae)
Chionaspis machili (Takahashi 1931)
Chionaspis schizosoma Takagi 1970
Fiorinia fioriniae (Targioni-Tozzetti 1867)

Leucaspi smachili Takagi 1969
Parlatoria camelliae Comstock 1883
Parlatoria machilicola Takahashi 1933
Silvestraspis uberifera (Lindinger 1911
)

Machilus sp. (Luraceae)
Asterolecanium machili Russell 1941
Ceroplastes floridensis Comstock 1881
Chionaspis machilicola (Takahashi 1935
)
Chionaspis schizosoma Takagi 1970
Chrysomphalus ficus Ashmead 1880
Diaonidia cinnamomi (Takahashi 1930
)
Eucalymnatus tessellatus (Signoret 1873)
Icerya seychellarum (Westwood 1855)
Laccifer greeni (Chamberlin 1923)
Metaspidiotus machili (Takahashi 1931
)
Paralecanium expansum (Green 1896)
Paralecanium machili Takahashi 1933
Parlatoria machilicola Takahashi 1933
Pseudaonidia trilobitiformis (Green 1896)
Saissetia formicarii (Green 1896)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Tachardina theae Green and Mann. 1907

Maesa japonica (Myrsinaceae)
Aspidiotus destructor Signoret 1869

Maesa sinensis (Myrsinaceae)
Ceroplastes floridensis Comstock 1881

Maesa sp. (Myrsinaceae)
Hemiberlesia cyanophlli (Signoret 1869
)
Metaspidiotus stauntoniae (Takahashi 1933)

Maesa tenera (Myrsinaceae)
Aonidiella aurantii (Maskell 1878)
Aonidiella citrina (Coquillett 1891)
Aulacaspis maesae Takagi 1970

Magnolia sp. (Magnoliaceae)
Pseudococcus aonidum (Westwood 1839)

Mahonia japonica (Berberidaceae)
Chrysomphalus ficus Ashmead 1880

Mallotus japonicus (Euphorbiaceae)
Cerococcus ficoides Green 1899
Planococcus lilacinus (Cockerell 1905)
Pseudaulacaspis pentagona (Targioni-Tozzetti 1855)

Mallotus philippinensis (Euphorbiaceae)
Coccus hesperidum Linnaeus 1758
Icerya aegyptica (Douglas 1890)

Mallotus sp. (Euphorbiaceae)
Planococcus lilacinus (Cockerell 1905)
Pseudococcus macarangae Takahashi 1940

Manihot esculenta (Euphorbiaceae)
Cocomytilus albus (Cockerell)

Mangifera indica (Anacardiaceae)
Aspidiotus destructor Signoret 1869
Aulacaspis tubercularis Newstead 1906
Ceroplastes ceriferens (Anderson 1791
)
Ceroplastes floridensis Comstock 1881
Ceroplastes rubens Maskell 1892
Coccus hesperidum Linnaeus 1758
Coccus mangiferae (Green 1889)
Eucalymnatus tessellatus (Signoret 1873)
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Hemiberlesia cyanophylli (Signoret 1869)
Icerya seychellarum (Westwood 1855)
Laccifer greeni (Chamberlin 1923)
Lindingaspis rossi (Maskell 1890)
Parlatoria proteus (Curtis 1843)
Pulvnaria psidii Maskell 1892
Pulvinaria taiwana Takahashi 1929
Saissetia formicarii (Green 1896)
Saissetia hemisphaerica (Targioni-

Tozzetti 1867)
Vinsonia stellifera (Westwood 1871)
Melastoma candidum (Melastomataceae)
Ceroplastes ceriferens (Anderson 1791 )
Melia azedarach (Meliaceae)
Aulacaspis crawii (Cockerell 1898)
Lepidssaphes tubulorum Ferris 1921
Michelia alba (Magnoliaceae)
Coccus hesperidum Linnaeus 1758
Pseudaulacaspis cockerelli (Cooley 1897)
Saissetia formicarii (Green 1896)
Michelia champaca (Magnoliaceae)
Aspidiotus destructor Signoret 1869
Michelia formosana (Magnoliaceae)
Tachardina theae Green and Mann 1907
Michelia fuscata (Magnoliaceae)
Pseudanonidia duplex (Cockerell 1896)
Pseudaulacaspis cockerelli (Coo ey 1897)
Tachardina theae Green and Mann 1907
Michelia longifolia (Magnoliaceae)
Coccus acutissimus (Green 1896)
Coccus hesperidum Linnaeus 1758
Tachardina theae Green and Mann 1907
Michelia sp. (Magnoliaceae)
Coccus acutissimus (Green 1896)
Saissetia formicarii (Green 1896)
Milletia nitida (Leguminosae)
Coccus elongatus (Signoret 1873)
Coccus hesperidum Linnaeus 1758
Miscanthus sinensis (Graminae)
Kiritshenkella cellulosa (Hall 1923)
Pilococcus miscanthi Takahashi 1928
Pygalataspis miscanthi Ferris 1921
Trionymus latus Takahashi 1929
Miscanthus sp. (Gramineae)
Acanthomytilus chui Takagi 1970
Acanthomytilus sacchari (Hall 1923)
Aulacaspis divergens Takahashi 1935
Lecanopsis sacchari Takahashi 1928
Miscanthicoccus miscanthi (Takahashi 1928)
Neoripersia miscanthicola (Takahashi 1937)
Pilococcus miscanthi Takahashi 1928
Pseudococcus takahashii Lindinger 1931
Trionymus diminutus (Leonardi 1917 )
Monstera deliciosa (Araliaceae)
Parlatoria proteus (Curtis 1843)
Morus alba (Moraceae)
Ceroplastes ceriferens (Anderson 1791 )
Coccus elongatus (Signoret 1873)
Icerya aegyptica (Douglas 1890)
Icerya seychellarum (Westwood 1855)
Planococcus citri (Risso 1813)
Pseudaulacaspis pentagona (Targioni-Tozzetti 1855)
Saissetia nigra (Niether 1861)
Morus sp. (Moraceae)
Aspidiotus destructor Signoret 1869
Pulvinaria maxima Green 1904
Murraya paniculata (Rutaceae)
Aulacaspis murrayae Takahashi 1931
Murraya exotica (Rutaceae)
Coccus bicurciatus (Green 1904)
Lepidosaphes beckii (Newman 1869)
Pseudaonidia trilobitiformis (Green 1896)
Pulvinaria neocellulosa Takahashi 1940
Pulvinaria polygonata Cockerell 1905
Musa sapientum (Musaceae) *
Aonidiella comperei McKenzie 1937
Chrysomphalus ficus Ashmead 1880
Pinnaspis muntingi Takagi 1965 (M. sapieus)
Saissetia nigra (Nietner 1861)

Musa sp. (Musaceae)
Aspidiotus destructor Signoret 1869
Mussaenda luteola (Rubiaceae)
Nipaecoccus filamentosus (Cockerell 1893)
Myrica rubra (Myricaceae)
Coccus elongatus (Signoret 1873)
Fiorinia taiwana Takahashi 1934
Paralecanium expansum (Green 1896)
Tachardina theae Green and Mann 1907
Myristica heterophylla (Myristicaceae)
Ceroplastes rubens Maskell 1892
Chrysomphalus ficus Ashmead 1880
Fiorinia fioriniae (Targioni-Tozzetti 1867)
Saissetia formicarii (Green 1896)
Nephelium litchi (Sapinaceae)
Coccus elongatus (Signoret 1873)
Laccifer lacca (Kerr 1782)
Thysanofiorinia nephalii (Maskell 1898)
Nerium indicum (Apocynaceae) *
Pseudaulacaspis cockerelli (Cooley 1897)
Nerium odorum (Apocynaceae)
Saissetia oleae (Bernard 1782)
Ferrisiana virgata (Cockerell 1893)
Nipaecoccus filamentosus (Cockerell 1893)
Neolitsea acuminutissima (Lauraceae)
Aulacaspis alisiana Takagi 1970
Neolitsea sp. (Lauraceae)
Aulacaspis yabunikkei Kuwana 1926
Olea europaea (Oleaceae) *
Saissetia formicarii (Green 1896)
Oplismenus sp. (Gramineae)
Aulacaspis madiunmensis (Zehntner 1898)
Oryza sativa (Gramineae)
Trionymus taiwanus Takahashi 1932
Osmanthus fragrans (Oleaceae)
Chrysomphalus ficus Ashmead 1880
Coccus elongatus (Signoret 1873)
Parlatoria pergandei Comstock 1881
Pinnaspis uniloba (Kuwana 1909)
Saissetia hemisphaerica (Targioni-Tozzetti 1867)
Osmanthus sp. (Oleaceae)
Parlatoria proteus (Curtis 1843)
Palaquium formosanum (Sapotaceae)
Ceroplastes rubens Maskell 1892
Chrysomphalus ficus Ashmead 1880
Coccus mangiferae (Green 1889)
Eucalymnatus tessellatus (Signoret 1873)
Laccifer greeni (Chamberlin 1923)
Saissetia formicarii (Green 1896)
Palm (Palmae)
Fiorinia minor Makell 1897
Pandanus boninensis (Pandanaceae) *
Aspidiotus destructor Signoret 1869
Pandanus sp. (Pandanaceae)
Pseudococcus comstocki (Kuwana 1902)
Pandanus tectorius (Pandanaceae)
Aspidiotus destructor Signoret 1869
Chrysomphalus ficus Ashmead 1880
Parlatoria pergandei Comstock 1881
Panicum grantum (Gramineae)
Ferrisiana virgata (Cockerell 1893)
Passiflora edulis (Passifloraceae) *
Planococcus citri (Risso 1813)
Persea gratissima (Lauraceae)
Ceroplastes ceriferens (Anderson 1791)
Ceroplastes rubens Maskell 1892
Drosicha contrahens Walker 1858
Ferrisiana virgata (Cockerell 1893)
Icerya seychellarum (Westwood 1855)
Planococcus citri (Risso 1813)
Saissetia formicarii (Green 1896)
Phalaenopsis amabilis (Orchidaceae)
Parlatoria proteus (Curtis 1843)

Phoebe formosana (Lauraceae)
Aulcaspis phoebicola Takahashi 1936
Phoenix sp. (Palmae)
Pseudaulacaspis cockerelli (Cooley 1897)
Phragmitis sp. (Gramineae)
Antonina indica Green 1908
Aspidiella phragmitis (Takahashi 1931)
Greenaspis elongata (Green 1899)
Kuwanaspis phragmitis Takahashi 1931
Nikkoaspis hichiseiana (Takahashi 1934)
Phyllostachys pubescens (Bambasaceae)
Kuwanaspis suishana (Takahashi 1930)
Pinus thunbergii (Pinaceae)
Fiorinia japonica Kuwana 1902
Poliaspis pini (Maskell 1897)
Pinus sp. (Pinaceae)
Chrysomphalus ficus Ashmead 1880
Hemiberlesia pitysophila Takagi 1969
Lepidosaphes pitysophila Takagi 1970
Pyrus serotina (Rosaceae)
Andaspis hawaiensis (Maskell 1894)
Inglisia formosana Takahashi 1930
Pyrus sp. (Rosaceae)
Saissetia nigra (Nietner 1861)
Pithecolobium dulce (Mimosaceae)
Coccus elongatus (Signoret 1873)
Pittosporum tobira (Pittosporaceae)
Lopholeucaspis japonica (Cockerell 1897)
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## Explanation of localities into Chinese

Alishan 阿里山
Changhua 彰化
Chaochow 潮州
Chiayi 嘉義
Chiaochi 礁溪
Chihpen 知本
Chishan 旗山
Chuchi 竹崎
Chushan 竹山
Erhshui 二水
Fengliao 枋寮
Fenchifu 奮起湖
Fengshan 鳳山
Fengyuan 豐原
Henchun 恆春
Hsinchu 新竹
Hsinchung 新莊
Hsinhua 新化
Hsinpu 新埔
Hsintien 新店
Hualien 花蓮
Ilan 宜蘭
Kangshan 岡山
Kaohsiung 高雄
Keelung 基隆
Kenting 墾丁
Kuantzuling 關子嶺
Lanhsu 蘭嶼
Lopei 老埤
Lotung 羅東
Matou 麻豆
Meifeng 梅峰
Miaoli 苗栗
Nengkao 能高
Ouluanpi 鵝鑾鼻
Pashiesnhan 八仙山
Peipu 北埔
Peitau 北投
Penghu 澎湖
Pingchien 平鎮
Pingtung 屏東
Puli 埔里
Sanhsia 三峽
Shihlin 士林
Shuishe 水社
Shihting 石碇
Sungkang 松崗
Suo 蘇澳
Taichung 臺中
Tainan 臺南
Taipei 臺北
Taipingshan 太平山
Taishu 大樹
Taitung 臺東
Tanshui 淡水
Taoyuan 桃園
Toko 土庫
Tungpu 東埔
Tungshih 東勢
Tuniu 土牛
Wulai 烏來
Wushe 霧社
Yangmingshan 陽明山
Yunlin 雲林
Yensuikong 鹽水港
Yuanlin 員林
Yuanshan 圓山
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# 宜蘭低產水田土壤與性質施用矽酸鈣、稻草、重肥及暗渠排水改良效果關係之研究[1]

陳 春 泉[2]

摘要：1.宜蘭淺層土壤及排水不良稻田面積廣大，水稻患病率高，產量低落，亟待改良，乃於三星淺層剖面土壤及冬山排水不完全土壤，舉辦改良試驗。

2.三星以施用矽酸鈣、稻草、重磷鉀及鉀穗肥等處理。冬山除此等處理外並加暗渠排水，即以谷殼爲暗渠排水溝之填充材料，每距50公分設平行暗渠一條，作改良試驗。

3.結果冬山排水不完全土壤，以谷殼作暗渠排水對不設暗渠，施用稻草者，谷增產15%（二期5.4%），不施稻草者增產13%（二期10%）。

4.冬山施用稻草，一期增產31%（二期稻殘效21%）。故土地生產力低者，稻草有增產之效果。

5.冬山重磷鉀鉀穗肥對普通肥料區增產11.5%（二期0.4%）。

6.冬山施用矽酸鈣 3,000kg/ha 並重磷鉀肥鉀穗肥對普通肥料區增產 45.7%（二期14.8%）。

7.三星施用稻草微有減產，但差異不顯著，故土地生產力高者稻草之效果不明顯。

8.三星施用矽酸鈣加重磷鉀鉀穗肥谷略有增產，但差異不顯著。矽酸鈣加重磷鉀鉀穗肥對重磷鉀鉀穗肥，稻草增產達5%顯著度。

9.三星土壤深度差異大，表土厚度與谷產量，土層厚度與谷產量均成顯著之相關；谷產量與此二種土壤厚度，複相關亦極顯著，相關係數各爲0.48**、0.49**及0.56**。土層厚度達65公分以上，土層加厚則不再增產。故土層厚度以65公分爲佳，若小於65公分則恐難望極高之產量。

10.在冬山水稻體含 $SiO_2$ 量與葉稻熱病成負相關，與谷產量成正相關，矽及排水爲主要增產因素。三星一期作因特別注意防病，則 $SiO_2$ 之含量不構成重要增產因素。

11.二期作三星施矽酸鈣區，不噴病藥者產量比噴病藥者爲高。其他處理則反是。冬山大體上暗渠排水者，不噴藥區谷產量高於噴藥者，不排水者則反是。

12.排水可增進水稻對 $SiO_2$ 之吸收，亦有促進其他元素有效性之趨勢。

13.三星試驗地土地生產力中上，土壤含置換性 Ca、Mg 有效性 P、K 均較冬山爲高。其植物體含量亦較高。因三星土壤培肥佳。故改良土壤須從分析土壤及植物，觀察土壤剖面形態，並對照作物產量諸方面通盤加以研究，而探尋水稻增產之對策。

## 前 言

宜蘭縣水田土壤；較少受人注意。由於民國64年秋天，舉行宜蘭縣土壤詳測，始發現約在30,000公頃耕地中，有6,000公頃爲土層深度僅有 10—40公分之水田，當年二期作水稻普遍遭受嚴重病蟲爲害，且穗數少（每欉8—13穗）。又在冬山、五結及莊圍、礁溪等鄉，地位低之水田近一萬公頃，稻穗病亦烈，水稻產量甚低，雖整修大排水溝後土壤仍是排水不良狀態(5)。

野外工作時，所遇農友，皆以此低產問題相詢。

經觀察三星淺層土壤地帶，自宜蘭濁水溪引進濁水灌溉，凡稻田之入水口，沉積泥沙較多，水稻穗病率亦較低，可能因土壤中有效性矽不足(13)，而入水口處泥沙中所含較多而使水稻較爲健康。連

1. 臺灣省農業試驗所 研究報告 第 834 號。

2. 臺灣省農業試驗所技正。

深先生證明本省北部土壤，施用 $SiO_2$，水稻可增產 9—13%[2,3]。排水不良，亦爲水稻產量減低誘因之一。連深先生在彰化得此印證[1]，三井進午等研究土壤還元，水稻根生長受其阻害[6]。Malcolm 等試驗，水化氧化鐵鋁能吸收 Si $(OH)_4$[10]，故還元土壤有效 Si 將降低，而使水稻吸收不足。Giordano 等以14日幼苗作試驗，$MnCl_2$、$FeCl_2$ 在 $10^{-4}$M 濃度時，減低根對 Zn 之吸收及轉運[7]。故土壤排水當可促進水稻生長。再查淺層土壤或產量較低之較瘠土壤，由於土壤肥力不繼，農民每於水稻生長後期，補施氮肥，以致抽穗期水稻莖葉過分幼嫩，且宜蘭於秋末常有陰雨，稻病之發生率勢將大增，如能施用稻草以補充土壤所缺之有機質，使所施氮肥較少損失而增其效能[8,9]，或能補救此一缺點。

基於上述原因，於民國65年，在三星淺層土壤區及冬山排水不良土壤區，舉行稻田排水，施用稻草、重磷鉀肥及鉀穗肥綜合試驗，以探討此二種水田土壤之改良效果及對策。

## 試驗材料

土壤：冬山土壤；母質爲片岩，土層深度大於120公分餘質地爲坋質粘壤土，於 40至70公分處呈暗灰色，爲集水之象徵，但70公分以下土壤，則爲淺灰色深層冲積土，此一帶過去「稻病」問題頗爲嚴重，普通產量僅3,000公斤／公頃左右。三星鄉大州土壤，土層深度變異大（自25—85公分），以35—45公分者居多，爲老河床地，母質爲粘板岩，質地爲坋質壤土，排水佳，經營農民爲篤農家，土壤培肥佳，生產力中上。至於土壤成分，請閱後文。

矽酸鈣：稻草及谷殼：矽酸鈣爲省產，其主要成分爲 $SiO_2$ 31%，CaO 44%，MgO 1.7%。稻草及谷殼爲農戶所供應。

## 試驗方法

Ⅰ.處　　理

1.稻草效果試驗

（1）稻草量 3,000kg/ha 及 6,000kg/ha二平準（稻草於插秧前29日埋入，二期作不施稻草）。

（2）埋稻草時施用 NP 肥料 不施 NP（2.4處理）及施 N 27%，P 100%（1.3處理）二平準。共四處理，各處理施用 N 144kg/ha（二期 85，兩期皆因稻葉濃綠不施穗肥），$P_2O_5$ 及 $K_2O$ 各 60kg/ha。

2.施用肥料試驗

（5）普通肥料區 N 120kg/ha（二期85），二期不施穗肥，以下各處理同，因恐雨天發病之故。$P_2O_5$ 及 $K_2O$ 各60kg/ha。

（6）重磷鉀及鉀穗肥 N 120kg/ha（二期85），$P_2O_5$ 100kg/ha 及 $K_2O$ 120kg/ha。

（7）肥料同（6）加施矽酸鈣，每期作 3,000kg/ha。

（8）同（6）處理，原定爲乾整地，因遇雨，無法執行，故實際同處理（6），（冬山設此處理，三星不設此處理）。

NK 分施%列於表 1。

表1. N K 分 施 %

稻 草 試 驗

| 期作 | 要 素 | 基肥 | 一追 | 二追 | 三追 | 穗肥 |
|---|---|---|---|---|---|---|
| 一期 | N (%) | 40 | 20 | 17 | 15 | |
| | $K_2O$(%) | 30 | 10 | 27 | 30 | |
| 二期 | N (%) | 29 | 36 | 35 | | |
| | $K_2O$(%) | 35 | 40 | 25 | | |

1.二試驗以 $P_2O_5$ 100% 作基肥。
2.稻草試驗埋草施用 NP 處理於水稻基肥時減施等量之 NP.
3.施肥量及%爲實際施用量。

肥 料 試 驗

| 期作 | 處 理 | 要素 | 基肥 | 一追 | 二追 | 三追 | 穗 肥 |
|---|---|---|---|---|---|---|---|
| 一期 | 處 理 5 | N | 15 | 30 | 25 | | |
| | | $K_2O$ | 35 | 40 | 25 | | |
| | 處 理 6 7 8 | N | 15 | 30 | 25 | | |
| | | $K_2O$ | | 10 | 30 | 15 | 15 |
| 二期 | 各 處 理 | N | 19 | 46 | 35 | 40 | 20 |
| | 處 理 5 | $K_2O$ | 35 | 40 | 25 | | |
| | 其他處理 | $K_2O$ | 10 | 10 | 30 | 40 | 20 |

3.排水處理　設在多山，上述1，2試驗各處理又分爲排水和不排水二處理。

Ⅱ.田間排列　三星各處理重覆五次，完全逢機區集。多山裂區排列， 以排水及不排水爲主區，其他各處理爲副區，重覆四次。

二處之1，2試驗併列於同一塊土地，以便比較稻草及其他肥料之效果。

Ⅲ.多山暗渠排水方法　試驗區主區爲排水處理者，每隔50公分開掘寬10公分，深 35公分平行溝，填入谷殼，高10公分，然後塡入原掘出之土壤至平。溝之兩端，各開寬30公分，深45公分之明溝，導水至田外，然後整地插秧。不排水處理者，僅行整地。

Ⅳ.小區面積　多山 3 × 6 公尺=18平方公尺；三星 6 × 4 公尺=24平方公尺。

Ⅴ.採樣及收穫　每小區留水稻二行，供採植株樣品，於最高分蘗期及幼穗形成期各取一次， 每次每小區取 5 個半欉；收穫時採谷及藁，各處理四（或五）重覆樣品混合後，取樣一個。

## 結　果

水稻產量列於表 2 及表 3 。依表 2 及 3 所示：

1.產量低之多山水田，以普通肥料（處理 5 ）爲標準時，施用稻草一期增產谷23%，二期作稻草殘效增產谷 9 %。但在土壤培肥佳之三星大州土壤（雖爲淺層土），處理 5 一期谷產量高於稻草區（ 5 %），二期則 6 %。

故土壤生產力低者，稻草有增產之效，如土壤生產力高，則稻草之效果不可靠 ，與 Yong 以抽出腐植質施於玉米苗，土壤有機物低者，反應良好，反之，土壤有機物高者 ， 則得負反應或無反應[15]之情形近似。

2.就生產力低之多山水田言，一、二期作施用稻草3,000 及 6,000kg/ha，效果無大差異。

3.埋草時施用 N P 肥料時，一、二期作皆比不施 N P 者略有減產，但差異不顯著。至於三星試驗地，此二處理仍無較明顯之差異。故一期作施用稻草後29天插秧， 再在插秧時施 N P 基肥，似不致於發生因稻草分解微生物之競爭而使水稻缺氮之狀況。 故埋入稻草時不必施用 N 肥乃可減短其在田中散失之時間。

4.稻草產量，除多山一期作 3,000公斤／公頃於稻草埋草時施用 N P 肥料比不施者高達 1 %顯著度，及二期作不施 N P 者比施用 N P 者高近 5 %顯著度外，其餘差異皆不顯著。

水稻產量（公斤／公頃）

## 表 2. 稻草及排水處理水稻產量比較表

### A. 多山試驗地

### (A) 稻 草 處 理

| 處理 | | 穀產量 稻草用量 3,000kg/ha 重複平均 | 平均 | 6,000kg/ha 重複平均 | 平均 | 平均 | | 草產量 稻草用量 3,000kg/ha 重複平均 | 平均 | 6,000kg/ha 重複平均 | 平均 | 平均 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 埋草施肥 | 排水 | | | | | | | | | | | | |
| **一 期 作** | | | | | | | | | | | | | |
| 埋草時不施肥 | 排 水 | 4763 | 4291.5 | 4699 | 4505.5 | 4731 | 4401 | 3724 | 3585.5 | 3949 | 3790.5 | 3836.5 | 3688 |
| | 不排水 | 3820 | | 4312 | | 4066 | | 3447 | | 3632 | | 3539.5 | |
| 埋草時施肥 | 排 水 | 4551 | 4295.5 | 4324 | 4050 | 4437.5 | 4172.8 | 4057 | 3910.5 | 3950 | 3812 | 4003.5 | *△ 3861.3 |
| | 不排水 | 4040 | | 3776 | | 3908 | | 3764 | | 3674 | | 3719 | |
| 平 均 | | 4293.5 | | 4277.7 | | 4285.6 | | 3748 | | 3801.2 | | 3774.6 | |
| **二 期 作** | | | | | | | | | | | | | |
| 埋草不施肥 | 排 水 | 3294 | 3170 | 3250 | 3200 | 3271.5 | * 3184.5 | 2580 | 2512 | 2524 | 2523 | 2552 | △ 2517.3 |
| | 不排水 | 3046 | | 3150 | | 3097.5 | | 2443 | | 2522 | | 2482.5 | |
| 埋草施肥 | 排 水 | 3150 | 3088 | 3167 | 3074.5 | 3158.5 | 3081.3 | 2453 | 2416 | 2467 | 2460 | 2460 | 2437.5 |
| | 不排水 | 3026 | | 2982 | | 3004 | | 2378 | | 2453 | | 2415.5 | |
| 平 均 | | 3129 | | 3181.7 | | 3155.4 | | 2463.5 | | 2491.5 | | 2477.5 | |

### (B) 排水處理產量

| 處理 ＼ 期作 穀草 | 一期 穀 | 一期 草 | 二期 穀 | 二期 草 |
|---|---|---|---|---|
| 排 水 | 4584.3** | 3920*△ | 3215△ | 2505.5 |
| 不 排 水 | 3987 | 3629.3 | 3050.8 | 2449 |

B. 三 星 試 驗 地

| 處理 ＼ 期作 ＼ 穀草 | 一期 穀 kg/ha | | | 一期 草 kg/ha | | | 二期 穀 kg/ha | | | 二期 草 kg/ha | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 稻草用量 | 3000 | 6000 | 平均 | 3000 | 6000 | 平均 | 3000 | 6000 | 平均 | 3000 | 6000 | 平均 |
| 埋草時施肥 | 4937 | 5154 | 5046 | 4967 | 5138 | 5053 | 3447 | 3365 | 3406 | 3418 | 3380 | 3399 |
| 埋草時不施肥 | 5005 | 5136 | 5071 | 5004 | 5246 | 5125 | 3321 | 3347 | 3334 | 3216 | 3175 | 3196 |
| 平均 | 4971 | 5145 | 5049 | 4986 | 5192 | 5089 | 3384 | 3356 | 3370 | 3317 | 3278 | 3298 |

## 表 3. 水稻排水施用矽酸鈣及重磷鉀肥試驗產量 (公斤／公頃)

A. 多 山

| 處理 | | | 5 普通 | 6 磷鉀鉀穗肥 | 7 由6加矽酸鈣 | 8 同6處理 | 平均 | 指數 | LSD 1% | LSD 5% |
|---|---|---|---|---|---|---|---|---|---|---|
| 一期 | 穀 | A 不排水 | 3139 | 3446 | 4596 | 3411 | 3648△* | 88.54 | | |
| | | B 排水 | 3424 | 3872 | 4965 | 4220 | 4120.3 | 100 | | |
| | | 平均 | 3281.5 | 3659 | 4780.5 | 3815.5 | | | 749 | 547 |
| | 草 | A 不排水 | 3606 | 3539 | 3685 | 3843 | 3668.3 | 92.24 | | |
| | | B 排水 | 4003 | 3924 | 4056 | 3924 | 3976.8 | 100 | | |
| | | 平均 | 3804.5 | 3731.5 | 3870.5 | 3883.5 | | | | |
| 二期 | 穀 | A 不排水 | 2813 | 2666 | 3226 | 2621 | 2831.5* | 90.84 | | |
| | | B 排水 | 2965 | 3137 | 3406 | 2960 | 3117 | 100 | | |
| | | 平均 | 2889 | 2901.5 | 3316 | 2791 | | | 221 | 161 |
| | 草 | A 不排水 | 2662 | 2584 | 2616 | 2548 | 2602.8 | 101.11 | | |
| | | B 排水 | 2533 | 2598 | 2581 | 2585 | 2574.3 | 100 | | |
| | | 平均 | 2597.5 | 2591 | 2598.5 | 2566.5 | | | | |

B. 三 星

| 處理 | | 5 普通肥料 | 6 重磷鉀鉀穗肥 | 7 6加矽酸鈣 | 備考 |
|---|---|---|---|---|---|
| 一期 | 穀 | 5341 | 5210 | 5369 | |
| | 草 | 4929 | 4650 | 5063* | |
| 二期 | 穀 | 3574 | 3468 | 3653 | |
| | 草 | 3567 | 3548 | 3735 | |

5.暗渠排水處理之效果　表2及表3內顯示十分清楚，差異顯著度常超過1％故在多山，排水效果十分顯著，Puttaswamygwda 等試驗，排水有顯著之效果[11]。Sahoo 等試驗，重施有機肥料，而不排水，水稻產量大減[14]。

6.矽酸鈣之效果　表3肥料試驗，多山矽酸鈣加重磷鉀肥區谷產量，平均高達 4,781公斤／公頃。比普通肥料 3,282公斤／公頃，增產極為顯著，但在三星雖有增產，然而差異不顯著。

7.重磷鉀鉀穗肥在多山平均產量3,659公斤／公頃，比普通肥料區增產367公斤／公頃即10％，但差異不達顯著。

8.依調查結果，處理對水稻抗病有顯著的提高，故水稻增產多因減低病害率之結果。

## 討　論

試驗結果顯示了下列5項問題

1.適當處理，可提高水稻抗病力。

2.二地稻田生產力相差甚巨，多山最高產量處理為重磷鉀鉀穗肥並施矽酸鈣區，一期產量達4,965公斤／公頃，最低為普通肥料不排水區，一期產量僅3,139公斤／公頃。三星最高產量為重磷鉀鉀穗肥加矽酸鈣區，一期產量達5,369公斤／公頃，最低為重磷鉀鉀穗肥區，一期谷產量5,210公斤／公頃，故二處最高產量相差400公斤，最低產量相差近2,100公斤。

3.施用稻草，在多山效果大，但在三星無增產效果。

4.二期作產量不易由本試驗方法予以提高。多山最佳處理產量僅3,316公斤／公頃，三星亦僅3,653公斤／公頃，比一期作產量遠低。故二期作產量之提高方法值得研究。

5.排水處理為排水不良低產水田增產之有效方法。

6.矽酸鈣及重磷鉀肥之效果，因土壤環境及管理方法而異。

上列問題，就本試驗資料檢討如下：

(一) 處理增產多由增加水稻抗病力所引起。

1.稻熱病與水稻產量之關係。

a. 稻株 $SiO_2$ 含量與稻熱病之關係。

水稻生長期中，於最高分蘗期，幼穗形成期及收穫時採取稻藁樣品，所含 $SiO_2$ 之平均值因各處理而不同。多山水稻於最高分蘗期發生稻熱病，圖1為多山一期作各處理稻株 $SiO_2$ 含量平均值與稻熱病發生率之關係。施用矽酸鈣之處理7，植物體 $SiO_2$ 含量最高，稻熱病之發生率最低；施用稻草者 $SiO_2$ 含量也較普通肥料區為高，稻熱病亦有減低；而普通肥料不排水處理 5A 之 $SiO_2$ 含量最低，其稻熱病發生率也最高，與連 深先生51年試驗結果相符[3]。

在同圖內，排水處理 (B) 比不排水處理 (A) $SiO_2$ 含量皆高，而稻熱病皆低，排水處理與稻熱病之資料列於表4。

b. 稻株 $SiO_2$ 含量與穀產量之關係

圖1所示，多山一期作穀產量與稻株平均 $SiO_2$ 含量之關係；即凡 $SiO_2$ 含量高者，穀產量均高。

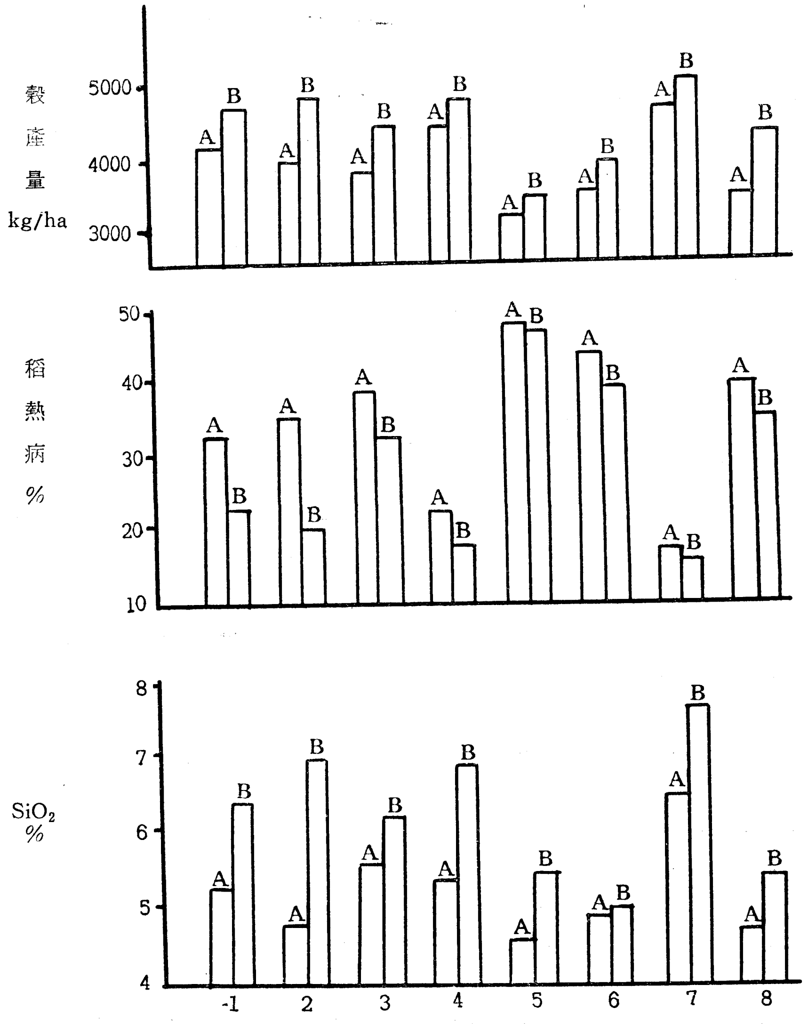
c. 稻熱病與穀產量之關係

圖1所示，多山一期作各處理稻熱病與穀產量之關係；即凡稻熱病率高者，穀產量均低。

d. 穀產量與稻熱病，稻株 $SiO_2$ 含量之相關

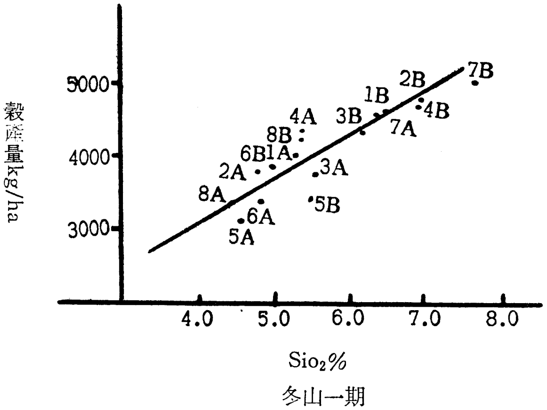
圖2為葉稻熱病與穀產量之相關及稻株 $SiO_2$ 含量與穀產量之相關，三者之互相關係至為明顯，此點與吳啓東先生等52及54年之試驗結果相符[24]。

葉稻熱病與穀產量之相關 $r=-0.95^{**}$，$N=16$，$y=5,622.37-48.75x$ 稻株 $SiO_2$ 含量與穀產量之相關 $r=0.89^{**}$，$N=16$，$y=1,032.56+531.41x$




多 山 一 期 各 處 理

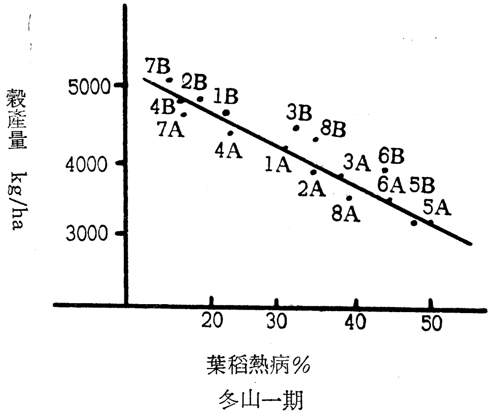
圖 1. 稻株各期 $SiO_2$ 含量平均稻熱病，穀產量之關係




Sio2%

多山一期

圖 2. 稻株各期 Sio2 含量與穀產量相關




葉稻熱病%

多山一期

稻熱病與穀產量相關

表 4. 處理與稻熱病發生率之關係

| 期作 | 噴藥處理 | 排水處理 | (1,2) 藁3000kg/ha | (3，4) 藁6000kg/ha | (5) 普通肥料 | (6) 重磷鉀 | (7) (6)+$SiO_2$ | (8) 同(6) | 比較說明 |
|---|---|---|---|---|---|---|---|---|---|
| **多山** | | | | | | | | | |
| **葉稻熱病 %** | | | | | | | | | |
| 一期 | 噴藥 | A 不排水 | 33 | 30.8 | 47.8 | 44.2 | 17.6 | 39 | 1 排水減輕病害。<br>2 $SiO_2$效果大。<br>3 重磷鉀有效果。<br>4 施稻草有效果。 |
| | | B 排水 | 21.2 | 24.7 | 47.6 | 38.8 | 15.5 | 34.8 | |
| **穗稻熱病 %** | | | | | | | | | |
| 一期 | 噴藥 | A 不排水 | 18.63 | 16.10 | 8.82 | 12.45 | 17.34 | 19.87 | 排水效果大。 |
| | | B 排水 | 10.05 | 10.81 | 9.88 | 12.61 | 7.19 | 10.67 | |
| **穗紋枯病 %** | | | | | | | | | |
| 二期 | 不噴藥 | A 不排水 | | | 11.1 | 12.8 | 13.6 | 29.3 | 排水效果最大。 |
| | | B 排水 | | | 4.2 | 2.6 | 1.3 | 0 | |
| | 噴藥 | A 不排水 | | | 20.4 | 35.5 | 16 | 15.7 | 1 排水效果大。 |
| | | B 排水 | | | 12.9 | 4.7 | 3.2 | 8.0 | 2 噴藥效果不若排水 |
| **穗稻熱病 %** | | | | | | | | | |
| 二期 | 不噴藥 | A 不排水 | | | 65.5 | 73.8 | 61.6 | 77.1 | 排水略有效果。 |
| | | B 排水 | | | 66.6 | 51.2 | 25.3 | 72.6 | |
| | 噴藥 | A 不排水 | | | 61 | 74.9 | 45.2 | 56.2 | 1 噴藥略有效果。 |
| | | B 排水 | | | 62.6 | 49.6 | 36.3 | 48.5 | 2 排水仍有效果。 |
| **三星** | | | | | | | | | |
| **穗頸稻熱病%** | | | | | | | | | |
| 一期 | 噴藥 | | 8.1 | 7.8 | 3.46 | 5.88 | 2.12 | — | 1 $SiO_2$效果大。<br>2 處理 5 少病因農家注意加以防病之結果。 |

註：稻穗一穗中有$\frac{1}{3}$穀粒罹病者，則爲病穗。

2. 各處理水稻抗病力與農藥防治力之比較

一期作發現適當處理可增加水稻之抗病力，乃於二期作留Ⅰ、Ⅱ兩重複不噴稻病防治農藥（但噴用防蟲農藥），Ⅲ、Ⅳ（三星至Ⅴ）重複依農民防治農藥照常噴藥，各處理重複平均發病率，例如表4，該表顯示各處理間之發病率差異顯著，且凡處理能提高水稻抗病力者，雖不噴農藥稻病率並不增高。噴藥處理各重複水稻產量平均減去不噴藥處理產量之差數，則為噴藥之效果（負數為抗病力有效果），列於表5。

表5. 第二期作各處理、噴藥效果（噴藥處理平均產量—不噴藥處理平均產量）

| 地區 | 穀草 | 排水 | (5) 普通肥料 | (6) 重磷鉀 | (7) (6) $+SiO_2$ | (8) 同（6） | 平均 |
|---|---|---|---|---|---|---|---|
| 冬山 | 穀 | A不排水 | 13.95 (4.8%) | −224.5(8.79%) | 388 (11.35%) | 888 (28.97%) | 297.8 (9.99%) |
| | | B排水 | −17 (0.58%) | −108 (3.5%) | −76.8 (2.28%) | 372.5(11.84%) | 42.8 (1.36%) |
| | 草 | A不排水 | 249 (8.94%) | 345 (12.52%) | 203 (7.47%) | 297 (11.02%) | 273.5 (9.99%) |
| | | B排水 | −82 (3.29%) | 206.5 (7.64%) | −253 (10.31%) | 283.5 (10.4%) | 38.8 (1.5%) |
| 三星 | 穀 | | 242.2 (6.6%) | 103.8 (3%) | − 32.2 (0.9%) | — | 104.6 (2.9%) |
| | 草 | | 108.3 (3%) | 233.2 (6.4%) | 233.7 (6.4%) | — | 191.7 (5.19%) |

施用稻草處理

| 地區 | 冬山 | | 三星 | |
|---|---|---|---|---|
| 穀或草 | 穀 | 草 | 穀 | 草 |
| A不排水 | 55.4 (1.8%) | 11.68 (4.66%) | 163.4 (4.76%) | 163.6 (4.87%) |
| B排水 | − 98.9 (3.12%) | − 78.8 (3.19%) | — | — |

（ ）內%係以表內差數為分子，噴藥處理相當產量平均值為分母所得，即不噴藥減（或增）產對噴藥區產量之%。

由表5所示，冬山谷產量差數，處理5、6、7之排水處理及三星谷之處理7，皆為負數；即表示不噴藥者比噴藥者產量為高。其餘處理大多數以噴藥重複產量比不噴藥者為高。由此足以證明水稻抗病力可由適當管理施肥處理予以提高，且其效果可能比藥劑防治為高。因藥劑防治可能因時機不適及氣候不當而效果減低，而抗病力可經常產生防病作用之故。又據 Zsoldos 試驗，以 Kitazin 防治稻熱病藥量達 $10^{-3}M \rightarrow 10^{-4}M$ 時，阻礙水稻對 K 及 P 之吸收，生長阻滯[16] 或可為噴藥反而減產之註脚。

本試驗似以排水配合施用矽酸鈣為最佳。若土壤排水良，可施用矽酸鈣。

（二）土地生產力問題

土地生產力之判斷，過去曾以土壤剖面性質及表土成分與水稻產量加以比較，但因農民管理技術不同，難獲一致之結果。今利用二土地之不同性質及管理方法而探討其與生產力之關係，裨為今後判斷土地生產力與改良土壤之參考。

土地生產力爲相當複雜的問題，不但與土壤性質有關且與所在環境關係密切。今試驗地皆在宜蘭，故大氣候不至於發生顯著差異，而微域氣候之差異，如風速、雨量、降雨時間則難免有某些程度之差異。唯多山及大州二試驗地相距僅十餘公里，皆不靠山或近海，其影響力當不至於顯著。故此二地之差異當以土壤性質之差異最爲重要。三星大州爲河床地粘板岩冲積土，土層淺排水良。而多山爲片岩冲積土，土層深質地偏細、排水不完全。三星之先天缺點爲土層太淺；而多山爲排水不完全，過去易患稻病之區域。關於水稻產量方面，三星爲中等土地，而試驗地爲篤農家所經營，平時管理佳，施用堆廐肥多，故產量比當地平均數爲高。多山土地爲當地比較佳之土壤，唯經營之農家爲平常農戶，地力並未加意培養，故土地生產力在平均數上下。茲就本試驗資料檢討試驗地之生產力。

1.土地生產力與土壤深度

三星爲老河床地，土壤深度變化大，田間發現普通肥料處理小區，各區產量差異大。經每小區掘開四孔，度量表土及土表至礫石層深度，以每小區四孔之平均值作爲該小區土壤深度，復統計全部小區谷產量與土壤深度之相關及複相關。相關係數如下：

| | 一期 | 二期 |
|---|---|---|
| 表土厚度與谷產量相關 | r=0.48** | 0.42** |
| 剖面土層深度與谷產量相關 | r=0.29 | 0.49** |
| 谷產量與土壤深度複相關 | r=0.506** | 0.566** |

由是以觀，表土厚度及剖面土層深度與谷產量相關達1％顯著度。再觀表6不論一或二期作，谷產量皆隨表土厚度而增。至於剖面土層深度方面，當深度小於65公分時，凡深度較大者，則產量較高，自65至85公分則產量不易因深度之增加而增。其原因可能有二：其一可能性爲水稻不需要大於65公分之土層，其二可能因土層加深後滲透性當較差，則可能影響水稻產量，則土壤較深之利被滲透性較弱之弊所抵消；雖土層更深亦難增產。因此吾人可以明瞭三星土壤僅有10—40公分厚度者，高產量將不易預期。改良土壤似宜以土壤容量（Capacity）之增加方面着想，例如增加土壤 CEC，引進濁水繼續灌溉等。

表 6. 三星土壤厚度與稻谷產量之關係

| | 土層cm<br>表土cm | 25 | 35 | 45 | 55 | 65 | 75 | 85 | 平　均 |
|---|---|---|---|---|---|---|---|---|---|
| 一期 | 17 | 4964.7<br>(3) | 5274.5<br>(2) | 4972<br>(2) | | | 5135.5<br>(2) | | 5073.1<br>(9) |
| | 19 | 5059.5<br>(2) | 4976.8<br>(5) | 5166.7<br>(3) | 5088.8<br>(4) | 5369<br>(1) | 5509<br>(1) | 5136<br>(1) | 5110.1<br>(17) |
| | 21 | | 5603<br>(1) | 5431.3<br>(3) | 5275.5<br>(2) | 5136<br>(1) | 5322.5<br>(2) | | 5358.8<br>(9) |
| | 平　均 | 5002.6<br>(5) | 5129.3<br>(8) | 5217.3<br>(8) | 5151<br>(6) | 5252.5<br>(2) | 5285<br>(5) | 5136<br>(1) | 5164.5<br>(35) |
| 二期 | 17 | 3290.3<br>(3) | 3309<br>(2) | 3294<br>(2) | | | 3403<br>(2) | | 3320.3<br>(9) |
| | 19 | 3394<br>(2) | 3394.8<br>(5) | 3325.3<br>(3) | 3602.8<br>(4) | 3769<br>(1) | 3804<br>(1) | 3499<br>(1) | 3501.2<br>(17) |
| | 21 | | 3516<br>(1) | 3436<br>(3) | 3544<br>(2) | 3534<br>(1) | 3612.5<br>(2) | | 3519<br>(9) |
| | 平　均 | 3331.8<br>(5) | 3415<br>(8) | 3394.5<br>(8) | 3583.2<br>(6) | 3651.5<br>(2) | 3567<br>(5) | 3499<br>(1) | 3459.3<br>(35) |

註（ ）內數字爲頻率。

2. 土地生產力與土壤及植物養分含量

（1）二試驗地試驗前後土壤成分比較

土壤試驗前後之成分，列於表 7，該表所示試驗前土壤 pH 及表土有機物含量，二土壤不相上下（三星底土有機物較高），而有效磷及有效鉀三星則較高，交換性鎂三星高出約 3.5倍，交換性鈣三星高近一倍（底土則近似），而鈣可增進谷產量[12]。唯一三星較爲低些者爲 $SiO_2$ 量。

試驗後則土壤成分各有不同程度之變化：

a. 多山

(a) pH 值除施矽酸鈣區外，皆降低不少。

(b) P 於多量 P K 區及一部分施用稻草區增加，而以施矽酸鈣之排水區增加最多。

表7. 土 壤 成 分

| 成分 | 處理 / 排水 | 一期試驗後 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 試驗前 表土 | 亞表土 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 多山 | | | | | | | | | | | |
| PH | A | 5.3 | 5.3 | 5.0 | 4.9 | 5.3 | 5.2 | 5.6 | 5.3 | 5.6 | 6.2 |
| | B | 5.2 | 5.2 | 5.1 | 5.2 | 5.4 | 5.2 | 5.9 | 5.5 | | |
| Bray $P_1P$ ppm | A | 19.1 | 24.2 | 22.7 | 22.8 | 17.2 | 20.1 | 25.0 | 22.9 | 19.1 | 18.4 |
| | B | 17.8 | 18.8 | 21.3 | 24.3 | 19.8 | 25.6 | 43.3 | 30.4 | | |
| Mehlich's K ppm | A | 30.4 | 34.4 | 30.0 | 31.4 | 23.8 | 32.4 | 44.8 | 31.6 | 33.8 | 14.4 |
| | B | 27.0 | 31.6 | 32.0 | 29.6 | 27.6 | 34.4 | 52.4 | 30.0 | | |
| 置換性 Ca me/100g | A | 3.12 | 3.12 | 3.47 | 2.81 | 2.78 | 2.73 | 4.22 | 2.89 | 2.89 | 3.20 |
| | B | 2.89 | 2.89 | 2.96 | 3.36 | 3.04 | 2.89 | 4.99 | 3.12 | | |
| 置換性 Mg me/100g | A | 0.41 | 0.43 | 0.41 | 0.42 | 0.36 | 0.42 | 0.44 | 0.36 | 0.44 | 0.57 |
| | B | 0.39 | 0.40 | 0.45 | 0.49 | 0.39 | 0.39 | 0.50 | 0.44 | | |
| $SiO_2$ ppm | A | 41 | 45 | 42 | 43 | 45 | 41.5 | 660 | 42 | 60 | 81 |
| | B | 45 | 47.5 | 45 | 52.5 | 62.5 | 42 | 1180 | 48.8 | | |
| 有機物（%） | | | | | | | | | | 4.5 | 1.5 |

三　　星

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | | 5.3 | 5.4<br>— | 5.4<br>— | 5.4<br>— | 5.3 | 5.5 | 5.6 | | 5.7 | 56 |
| Bray $P_1P$ ppm | | 24.5<br>— | 32.7<br>— | 30.7<br>— | 33.6<br>═ | 39.5<br>═ | 33.2<br>— | 37.8<br>⫽ | | 33.3 | 12.4 |
| Mehlich's K ppm | | 26.0 | 23.0 | 32.4 | 33.6 | 33.4 | 38.2 | 54.4<br>⫽ | | 45 | 31.2 |
| 置換性 Ca me/100g | | 1.42 | 1.44 | 1.41 | 1.44 | 1.33 | 1.44 | 1.40 | | 1.54 | 1.48 |
| $SiO_2$ ppm | | 46.3 | 47.5 | 42 | 42 | 47.5 | 48.3 | 115<br>⫽ | | 56 | 50 |
| 有機物（%） | | | | | | | | | | 4.5 | 2.98 |

註：上表內多山數字下"——"表示A或B較高"═══"表示較高且比試驗前爲高，"⫽"試驗前爲高。三星數字下"——"比多山同處理爲高，"═══"比多山同處理爲高且比較試驗前爲高，"⫽"比較試驗前高。

(c) K，一部分增加，以施 $SiO_2$ 區爲顯著。

(d) Ca，施稻草以不排水處理，不施稻草以排水處理增加明顯（又施矽酸鈣，增加Ca較多）。

(e) Mg，在施用矽酸鈣區增加，行排水者有略高之趨勢。

(f) $SiO_2$，排水者高於不排水者，加矽酸鈣者大有增加，故排水似有促進 $SiO_2$ 溶解之象徵。

b. 三星

(a) 除多施肥料處理外，試驗後土壤成分均低於試驗前。

(b) 試驗後 pH、P、Ca、Mg 皆比多山爲高，但 $SiO_2$ 則較少。

依上述情形判斷，排水似可促進土壤有效成分之增加，三星土壤生產力較高似與 P、K、Ca、Mg 較高有關（土壤排水情形較佳，亦可能有關）。

（2）植物養分含量之比較

表 8. 多山、三星植物體中養分含量%比較表

一　　期

| 地　點 | 排水處理 | 1—4 處理 | | | | | | 5—7 處理 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | Ca | Mg | $SiO_2$ | N | P | K | Ca | Mg | $SiO_2$ |
| **最高分蘗期** | | | | | | | | | | | | | |
| 多　山 | A | 3.54 | 0.37 | 2.4 | 0.3 | 0.19 | 5.3 | 3.85<br>— | 0.34 | 2.54 | 0.29 | 0.18 | 5.1 |
| 多　山 | B | 3.76<br>— | 0.37 | 2.35 | 0.3 | 0.20 | 6.3<br>— | 3.74 | 0.33 | 2.55 | 0.3 | 0.19 | 5.8 |
| 三　星 | | 3.73<br>— | 0.45<br>— | 2.41 | 0.35 | 0.26 | 5.8 | 4.12<br>— | 0.52<br>— | 3.05<br>— | 0.3 | 0.23 | 5.3 |

續表 8

| 地點 | 排水處理 | 1—4 處理 | | | | | | 5—7 處理 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | Ca | Mg | $SiO_2$ | N | P | K | Ca | Mg | $SiO_2$ |
| | | | | | 幼穗形成期 | | | | | | | | |
| 多山 | A | 2.05 | 0.27 | 2.03 | 0.3 | 0.24 | 4.8 | 1.88 | 0.28 | 1.97 | 0.3 | 0.20 | 5.0 |
| 多山 | B | 2.03 | 0.28 | 2.02 | 0.3 | 0.20 | 6.1 | 2.00 | 0.28 | 1.96 | 0.3 | 0.19 | 5.3 |
| 三星 | | 1.72 | 0.32 | 1.84 | 0.34 | 0.26 | 4.6 | 1.77 | 0.30 | 1.81 | 0.33 | 0.24 | 4.3 |
| | | | | | 藁 | | | | | | | | |
| 多山 | A | 0.70 | 0.08 | 1.23 | 0.24 | 0.15 | 5.7 | 0.73 | 0.10 | 1.38 | 0.23 | 0.13 | 5.6 |
| 多山 | B | 0.66 | 0.09 | 1.25 | 0.23 | 0.11 | 7.5 | 0.71 | 0.09 | 1.44 | 0.23 | 0.13 | 6.5 |
| 三星 | | 0.68 | 0.11 | 1.40 | 0.26 | 0.24 | 5.8 | 0.68 | 0.11 | 1.49 | 0.25 | 0.22 | 6.4 |
| | | | | | 穀 | | | | | | | | |
| 多山 | A | 1.38 | 0.20 | 0.25 | 0.09 | 0.12 | 1.9 | 0.97 | 0.21 | 0.26 | 0.08 | 0.11 | 1.7 |
| 多山 | B | 1.38 | 0.21 | 0.24 | 0.08 | 0.11 | 2.0 | 0.97 | 0.21 | 0.23 | 0.08 | 0.11 | 2.1 |
| 三星 | | 1.09 | 0.26 | 0.24 | 0.08 | 0.14 | 1.8 | 1.1 | 0.24 | 0.24 | 0.08 | 0.14 | 1.7 |
| | | | | | 二期 | | | | | | | | |
| | | | | | 最高分蘖期 | | | | | | | | |
| 多山 | A | 2.5 | 0.36 | 2.7 | 0.39 | 0.16 | 6.15 | 2.56 | 0.39 | 3.02 | 0.39 | 0.17 | 7.15 |
| 多山 | B | 2.6 | 0.35 | 2.64 | 0.38 | 0.15 | 6.8 | 2.71 | 0.35 | 2.77 | 0.36 | 0.13 | 6.5 |
| 三星 | | 2.28 | 0.35 | 2.51 | 0.40 | 0.31 | 4.45 | 2.22 | 0.34 | 2.71 | 0.37 | 0.23 | 5.27 |

續表 8

| 地點 | 排水處理 | 1—4處理 N | P | K | Ca | Mg | $SiO_2$ | 5—7處理 N | P | K | Ca | Mg | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **幼穗形成期** | | | | | | | | | | | | | |
| 多山 | A | 1.01 | 0.21 | 1.23 | 0.30 | 0.06 | 4.1 | 1.15 | 0.21 | 1.47 | 0.30 | 0.08 | 4.8 |
| 多山 | B | 1.15 | 0.23 | 1.4 | 0.30 | 0.06 | 5.3 | 1.20 | 0.22 | 1.50 | 0.30 | 0.06 | 5.6 |
| 三星 | | 0.90 | 0.22 | 1.17 | 0.25 | 0.13 | 4.0 | 1.05 | 0.23 | 1.47 | 0.27 | 0.10 | 4.67 |
| **藁** | | | | | | | | | | | | | |
| 多山 | A | 0.69 | 0.10 | 1.16 | 0.33 | 0.08 | 7.1 | 0.83 | 0.14 | 1.58 | 0.30 | 0.07 | 7.2 |
| 多山 | B | 0.69 | 0.09 | 1.49 | 0.30 | 0.03 | 8.0 | 0.78 | 0.11 | 1.84 | 0.30 | 0.06 | 8.2 |
| 三星 | | 0.73 | 0.12 | 1.78 | 0.33 | 0.08 | 6.0 | 0.71 | 0.10 | 1.93 | 0.35 | 0.06 | 6.67 |
| **穀** | | | | | | | | | | | | | |
| 多山 | A | 1.06 | 0.24 | 0.21 | 0.46 | 0.10 | 1.50 | 1.01 | 0.24 | 0.22 | 0.46 | 0.10 | 1.9 |
| 多山 | B | 0.97 | 0.25 | 0.23 | 0.53 | 0.10 | 1.90 | 1.06 | 0.24 | 0.22 | 0.43 | 0.09 | 1.9 |
| 三星 | | 0.96 | 0.24 | 0.24 | 0.45 | 0.11 | 1.70 | 0.94 | 0.24 | 0.24 | 0.40 | 0.10 | 1.67 |

註：三星數字下加"——"爲比多山高，多山A或B數字下加"——"者爲二者中之高者。

由上表所示：

a. 最顯著者爲排水促進水稻對 $SiO_2$ 之吸收，是爲其增加耐病力之主要原因。

b. 一期作排水處理於最高分蘖期水稻含 N 略高。

c. 排水處理對水稻其他養分之含量，未見有良好影響。

d. 三星土地生產力較高，而一期水稻中 P、Ca、Mg（有時 N、K）比多山者含量爲高。二期三星水稻 Mg 含量比多山略高而 N、P、K 及 Ca 偶有略高者。

再由表 7 土壤成分比較，三星土壤中 Bray$P_1$P、Mehlich's K，置換性 Ca、Mg 皆比多山爲高，但 $SiO_2$ 則稍低，故植物體養分之高低與土壤成分之高低兩相符合。三星產量較高不無理由。故多山土壤如能改進肥培管理方法，並行排水，理想之產量不難獲得。

## 結　論

增產水稻常以調節 NPK 肥料爲手段，但觀多山 N 120公斤／公頃 ，重 PK 及 K 穗肥 ($P_2O_5$ 100kg/ha, $K_2O$ 120kg/ha) 雖有效果，但產量仍遠低於三星普通肥料區；故欲以 NPK 增產水稻在某種程度以外，則非改良土壤不可。

三星土壤產量雖相當高，但前節說明，因土層太淺，產量無法提高尙有改良之必要。

本試驗結果第一項說明：土壤生產力低之多山水田，施用稻草增產顯著；而生產力高之三星水田施用稻草似有減產之趨勢。故施用稻草可能爲某些生產力低水田之改良材料。排水不完全之多山土壤，排水爲增進水稻吸收 $SiO_2$ 及生長初期 N 素而增進其抗病力及增產之至佳方法。又前段所示，三星土壤所含 P、K、Ca 及 Mg 皆較多山土壤爲高 ，且三星水稻體之這些成分的含量，亦較多山爲高。就平常研究所悉，凡土壤肥培佳，常有 P、Ca 較高之趨勢 。而多山稻體中 Mg 常低，由於土壤中可置換性 Mg 極低，此點值得注意。故土壤肥培除經常施用堆廐肥等有機肥料之法外 ，可由土壤及植物分析探尋植物所需養分之含量及營養狀況，而由補充其缺少部分，使達平衡，亟待研究。

本試驗多山土壤，凡植物體中 $SiO_2$ 含量高者則產量較高；但三星土壤中 $SiO_2$ 含量略低 ， 稻體中含$SiO_2$ 亦常比多山排水處理低，但其產量反高。又三星一期作普通肥料處理產量相當高(5,341kg/ha) ，但水稻各期（最高分蘖期 ，幼穗形成期及藁）含 $SiO_2$ 量平均僅 5.0 %，而多山一期普通肥料不排水處理，其 $SiO_2$ 平均含量爲4.6%，而穀產量僅有 3,139kg/ha，普通肥料排水處理之 $SiO_2$ 含量爲5.5% ，而穀產量僅有 3,424kg/ha ，且多山產量最高之重磷鉀加矽酸鈣又排水處理其平均 $SiO_2$含量有 7.7%，其產量僅爲 4,965kg／ha。乃因三星農民於見到普通肥料處理患稻熱病較爲顯著時，則儘力加以撲滅。故 $SiO_2$ 對水稻之增產似以增進抗病力之主要原因 。 故在藥劑防治效果較差時，$SiO_2$ 則具顯著之效果。宜蘭及臺灣北部地區，陰濕天氣較多， 藥劑防治受某種程度之限制 ，效果常不高，$SiO_2$ 之施用仍屬必要。故改良土壤須視情形之需要，而補供矽酸鈣。

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# RESPONSE OF RICE TO AMANDMENT WITH SLAG, STRAW AND UNDER-GROUND DRAINAGE IN RELATION TO SOIL CHARACTERS OF LOW YIELD PADDY IN ILAN AREA[1]

by

Chen Chun Chuan

## Summary

1. Big portion of paddy field in Ilan area is low in yield due to shallow soil or poor draianage. It is an important problem for that area.

2. Field experiments were carried out on shallow paddy soil in Sansin by applying slag, straw, heavy dosage of P and K and split application of K at panicle initiation. And these treatments plus under-ground drainage were applied on imperfetly drained paddy in Tungshan. Drainage was made by digging parall ditches 50 cm apart one another, 35 cm deep, 10 cm wide and filled with rice hull to 25 cm below soil surface then covered with soil.

3. Results showed that in imperfectly drained soil, drainage increased grain yield 15% in the first crop and 5.4% in the 2nd crop when it was coupled with straw application. But 13% increase in the first crop and 10% in the 2nd crop was obtained by drainage from plots without straw application.

4. In Tungshan, 31% increase of grain yield by application of straw in first crop, and 21% increase by residual effect of straw in second crop. So that rice response to straw application on soil of low yield.

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1. Contribution No. 834 from the Taiwan Agricultural Research Institute.

5. In Tungshan, heavy dosage of P and K and split appliction of K at panicle initiation increased grain yield by 11.5% in first crop and only 0.4% in second crop.

6. In Tungshan, heavy dosage of P and K and split application of K at panicle initiation plus 3,000 kg/ha of slag (900kg/ha $SiO_2$) increased grain yield by 45.7 % for first crop and 14.8% for second crop.

7. Rice was not possitively affected by straw in fairly productive soil by good management in Sansin field.

8. In Sansin field, heavy fertilization and slag treatments raised grain yield insignificantly but they raised straw yield of first crop at 5% level of significant.

9. Grain yield of Sansin field was highly correlated with thickness of surface soil and thickness of soil profile with coefficient of 0.48** and 0.49** respectively. but yield did pnot increase with soil depth in the portion of>65 cm. In other words it is hardly to expect very high yield of rice in shallow soils. And no better effects might be expected by increasing depth of medium textured soil from 65 cm to deeper one.

10. In Tungshan field, slag and under-dround drainage were suitable ways for improving paddy soil. Minimizing blast disease was the main reason. Very carefull and effec tive control of blast made the function of slag invisible in Sansin field.

11. In Tungshan field, under-ground drainage was a better way for blast control of rice in comparison with fungicide. Slag was better than fungicide for the same purpose in both Tungshan and Sansin fields.

12. Drainage increased Si content of rice plants and there was a tendence to increase availability of other elements. in the Soil.

13. Soil in Sansin field contains more exchangeable Ca, Mg and available P and K resulting in higher content of these elemants in rice plants, and was more productive than that of Tungshan field. So that plant coupled with soil analyses may provide some infor mation for soil amendment practices.

# 高蛋白水稻之育種研究

## 1. 稉稻早晚熟品系間雜交後代之米粒蛋白質含量及其他農藝性狀之變異[1]

郭益全　謝順景　宋素英[2]

摘要：利用早晚熟性之 isogenic 系統的水稻為材料，藉各性狀頻度分布之圖形來描述雜種集團之米粒蛋白質含量及其他農藝性狀之遺傳變異。結果獲知早熟系統為相對短稈、穗短而輕之品系，並觀察到米粒蛋白質含量、株高、穗長及穗重等四性狀與抽穗期之早晚有某種關係存在，而早熟基因團則不影響原遺傳因子型之分蘖能力。文中並曾就各性狀之頻度分布圖形來初步描述各該性狀之族羣特徵。

## 緒　言

水稻為世界上最重要的穀類作物之一，而為臺灣之首要糧食作物。近年來，由於決策領導單位之大力推動暨水稻育種學者之奮力不懈，臺灣稻米年年均卜豐收。但，臺灣稻作年有二期，占了本省土地之主要作物栽培適期。而臺灣山多地狹，耕地面積有限，故裡作雜糧之栽培為提高本省土地之利用率以增加複種指數之最簡要方法。因應此裡作栽培制度，則豐產之早熟稻品種亟待育成。為達此目標，國立中興大學蔡國海博士曾以回交法育成各種以臺中65號為遺傳背景之早熟 isogenic 系統。此等早熟系統概較其輪迴親本臺中65號約早熟10天左右，但產量一般則較差（蔡，1961，1965）。

據學者之研究，抽穗期早者有蛋白質含量較高之傾向（Kido and Yanatori, 1965；Webb et al., 1968；Tanaka and Takagi, 1970；Tanaka, 1971, 1973；Harn et al., 1973；Hillerislambers et al., 1973）。故似可以藉早熟稻品種米粒蛋白質含量之提高以增加其米粒營養價值的方式來彌補產量略低之缺點。惟有關早熟品種之米粒蛋質含量的遺傳行為則未見有研究報告。為探討豐產早熟且高蛋白稻育成之可行性，乃利用各種早熟 isogenic 系統間之雜交 $F_2$ 為材料，進行米粒蛋白質含量及其他與產量有關諸性狀之遺傳變異的檢討。

## 材料及方法

本研究之供試水稻材料係國立中興大學蔡國海博士以水稻臺中65號為輪迴親本，藉連繫回交法所育成之早熟稻品系的5個雜交集團為材料，而其親本之特性則示於表1。

試驗在臺中市國立中興大學農藝學系之試驗農場進行。親本暨$F_2$之種子於1975年2月7日播種，3月10日挿秧。單本植。調查項目計有株高、穗數、穗長、穗重、結實率及 1,000粒重等性狀。米粒蛋白質含量之分析定量則應用 Udy 式之 DBC (Dye-Binding Capacity) 法，並依反應時溶液之溫度作適當之讀數矯正，而米粒蛋白質含量則以樣品含水量為零時來表示。

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1. 臺灣省農業試驗所 研究報告 第 835 號。本研究為第二作者任國立中興大學糧食作物研究所教授時蒙國科會輔助「臺灣主要糧食作物蛋白質改良之研究」（NSC—64B—049—04—06）之一部分。本試驗之水稻材料全係國立中興大學蔡國海博士所贈。謹誌謝忱。

2. 臺灣省農業試驗所技佐、農藝系主任、研究助理。

Table 1. Experimental materials used

| Strains or varieties | Cross parents | Source | Growth duration (days) | Genes for heading date | Note |
|---|---|---|---|---|---|
| 4-58-3 | T65×$A4_7$ | Dr. K. H. Tsai (Chung-Hsing University) | 117 | $m^a$ | A36−10：T65×$T_{tg}$. $A4_1$：T65×T36−10 |
| 40-20-5-6 | T65×A24 | Dr. K. H. Tsai (Chung-Hsing University) | 118 | $m^b$ | $A3_7$：T65× (T65×$T_{tg}$) $BC_7$. $A4_7$：$A3_7$× ($A3_7$×$A4_1$) $BC_6$. |
| BB-11-5-8-6 | $B96_{71}$×$B96_{151}$ | Dr. K. H. Tsai (Chung-Hsing University) | 107 | $E^{b(1)}-E^{b(2)}$ | $B96_{71}$：T65× (T65×Bozu) $BC_7$ $B96_{151}$：T65× (T65×Bozu) $BC_{15}$ |
| BI-1-4-11 | $B96_{71}$×$I199_{51}$ ($F_4$) | Dr. K. H. Tsai (Chung-Hsing University) | 109 | $E^{b(1)}-E^{ix(1)}$ | I190：X-ray induced early line of T65 $I190_{51}$：T65× (T65×190) $BC_5$ |
| BI-14-4-2-6 | $B96_{71}$×$I199_{51}$ ($F_5$) | Dr. K. H. Tsai (Chung-Hsing University) | 107 | $E^{b(1)}-E^{ix(1)}$ | |

## 結果與討論

茲將調查分析諸$F_2$集團各性狀之數據按組合別暨適當組距繪製各$F_2$集團諸性狀之柱狀頻度分布圖（圖1—7），並根據費氏（R. A. Fisher）之理論估算各性狀頻度分布圖形之歪度（Skewness）與峰度（Kurtosis）估值，同時給予適當之顯著性測驗，以初步描述各該集團各該性狀之若干特徵。今將結果按性狀之不同分別討論之：

一、雜交集團米粒蛋白質含量之變異

茲將各 $F_2$ 集團及其諸親本之米粒蛋白質含量變異示於圖1。由圖1中標出之早晚熟性稻品系之米粒蛋白質含量的平均値知，早熟品系 BB-11-5-8-6, BI-1-4-11 及 BI-14-4-2-6 等三品系之米粒蛋白質含量平均爲9.6%，較晚熟4—58—3品系之8.4%及40—20—5—6品系之 7.8%爲高。其平均值之差異顯著性測驗值亦達極顯著之水準，此證實早熟品系爲相對高蛋白品系。而此結果則與前人指出之抽穗期早者有米粒蛋白質含量較高之傾向的結果相同一致（Kido and Yanatori, 1965；Webb et al., 1968；Tanaka, 1971；etc）。

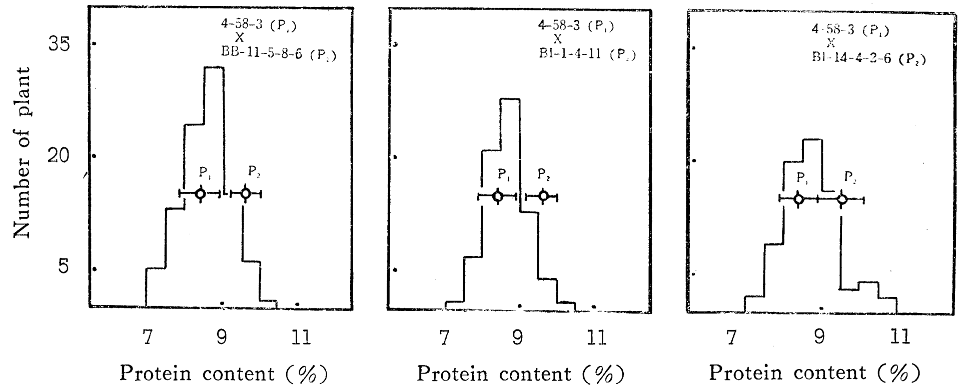
各$F_2$集團內個體之變異則概介於兩親本之間，而無正負兩方向超越雙親之個體出現，亦即由早晚熟性稻間之雜交似無超越分離之現象出現。同時，諸$F_2$集團之低蛋白質個體概集中分布於低親本（即晚熟親本）附近，此似表示控制米粒蛋白質含量之遺傳基因含量低者對高者似爲顯性，而此推論恰與 Hillenslambers et al. (1973) 之見解相符。

就米粒蛋白質含量之變異係數而言，各親本頗爲相近，表示諸親本之各觀測值的變異大體一致。而各組合之變異係數皆較各該兩親者爲大，表示$F_2$之變異除部分可能受環境之影響外，大部分應屬遺傳基因之分離與重組的變異所致，且各$F_2$組合之變異係數亦大數一致，表示各組合間個體之遺傳及環境變異頗爲相似。

另，Tanaka (1973) 曾由水稻之誘變研究中推論出，抽穗期與米粒蛋白質含量可能爲因子多效性之效果，而本研究由諸$F_2$組合個體之米粒蛋白質含量皆概集中於晚熟親本附近之事實，雖或可推定米粒蛋白質含量之高低與抽穗期之早晚可能具有某種關係，但在未作進一步估計之前，則未敢遽下推論。

其次，綜覽圖1各 $F_2$ 集團米粒蛋白質含量之頻度分布而知諸 $F_2$ 集團本性狀之頻度分布均呈連續分布，而再進一步參照表2米粒蛋白質含量頻度分布圖形之峰度與歪度之顯著性測驗值時，獲知諸$F_2$

集團米粒蛋白質含量之頻度分布圖形係屬常態或近似常態之連續分布。



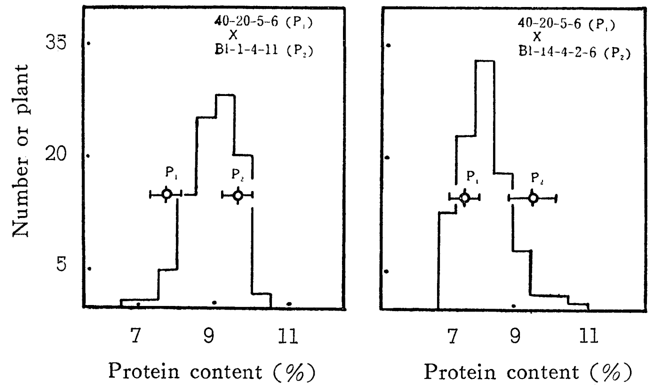




Fig. 1. Frequency distribution of percent protein in the $F_2$ of early x late crosses. (Cross figures indicate the parental mean with óe)

Table 2. Skewness ($g_1$) and kurtosis ($g_2$) of protein content and other characters estimated from $F_2$ population of early × late crosses.

| Crosses | Statistics | Protein % | Plant height | Panicle number | Panicle length | Panicle weight | % Seed setting | 1,000 Kernel weight |
|---|---|---|---|---|---|---|---|---|
| 4-58-3 × BB-11-5-8-6 | $g_1$ | 0.02 | 0.13 | − 0.07 | 0.63 | 0.68 | − 0.55 | − 0.86 |
| | $g_2$ | 0.17 | 0.22 | − 0.15 | 0.14 | 0.64 | 1.98 | 0.37 |
| | $g^1/SEg_1$ | 0.08 | 0.54 | − 0.29 | 2.63** | 2.83** | − 2.29** | 3.58** |
| | $g_2 9SEg_2$ | 0.34 | 0.44 | − 0.30 | 0.28 | 1.24 | 3.96** | 0.75 |
| 4-58-3 × BI-1-4-11 | $g_1$ | 0.21 | 0.04 | 0.94 | 0.35 | 0.65 | 0.58 | 0.82 |
| | $g_2$ | 1.02 | −0.52 | 2.73 | 0.71 | 0.76 | 0.66 | 0.49 |
| | $g_1/SEg_1$ | 0.75 | 0.14 | 3.39** | 1.25 | 2.32** | 2.07** | 2.93** |
| | $g_2/SEg_2$ | 1.85 | −0.94 | 4.98** | 1.29 | 1.38 | 1.20 | 0.89 |
| 4-58-3 × BI-14-4-2-6 | $g_1$ | 0.63 | −0.14 | 0.45 | − 0.09 | 0.17 | − 0.74 | −0.20 |
| | $g_2$ | 0.56 | −0.44 | − 0.63 | − 1.07 | − 0.70 | 0.69 | −0.70 |
| | $g_1/SEg_1$ | 2.25** | 0.05 | 1.61 | − 0.32 | 0.60 | − 2.64** | −0.71 |
| | $g_2/SEg_2$ | 1.03 | 0.81 | − 1.17 | − 1.98** | − 1.29 | 1.27 | −0.37 |
| 40-20-5-6 × BI-1-4-11 | $g_1$ | −0.46 | −0.51 | 0.48 | 0.48 | 1.42 | − 0.27 | 0.23 |
| | $g_2$ | 0.49 | 2.73 | 1.54 | − 0.29 | 1.38 | 3.67 | 1.11 |
| | $g_1/SEg_1$ | −2.71** | −2.10** | 2.00** | 2.00** | 5.92** | − 1.12 | 0.95 |
| | $g_2/SEg_2$ | 1.24 | 5.58** | 3.08** | 0.59 | 2.76** | 6.67** | 2.22** |
| 40-20-5-6 × BI-14-4-2-6 | $g_1$ | 0.86 | 0.14 | 0.51 | 0.45 | 0.19 | 0.30 | − 0.97 |
| | $g_2$ | 22.28 | 8.86 | 0.18 | − 0.66 | − 0.78 | 13.33 | 0.28 |
| | $g_1/SEg_1$ | 3.91** | 0.63 | 2.32** | 2.05** | 0.86 | 1.36 | 4.41** |
| | $g_2/SEg_2$ | 50.64** | 20.14** | 0.40 | 1.50 | − 1.77 | 30.30** | 0.63 |

二、株高之變異

株高爲品種特性之一。據 Tsai (1971) 之報告謂：早熟基因團 (E-gene block) 對植物之高度發生多效作用而減小其大小。本試驗中由圖2諸親本株高平均估值之觀察知，晚熟品系較早熟品系平均高約5—10公分左右。且$F_2$集團個體之株高也多集中分布於早熟親本之株高平均估值附近，似表示植株之高度與抽穗期之早晚可能確有某種關係存在，而其確切之相關關係則待進一步估計後再專文報告。

Mohamed and Hanna (1964)、Aquino and Jennings (1966)、Wu (1968a)、Heu et al. (1968) Yen (1968) 及 Li (1970) 等由 $F_2$ 頻分布之分割或藉全互交法遺傳成分之估計中，知控制株高之有效因子對數有1—4對；高者對矮者爲顯性；株高除受主效因子之控制，尙受具修飾作用之微效因子 (polygene) 所支配。而本研究中 $F_2$ 集團個體之株高亦概集中分布於低親本附近，而與上述前人之觀察不一致。同時，各 $F_2$ 集團之頻度分布呈常態或近似常態之連續分布圖形，援前人之報告證之於本研究中，似可建議，株高係受對數較多，效應相仿但易受環境影響其表現之微效因子所控制。

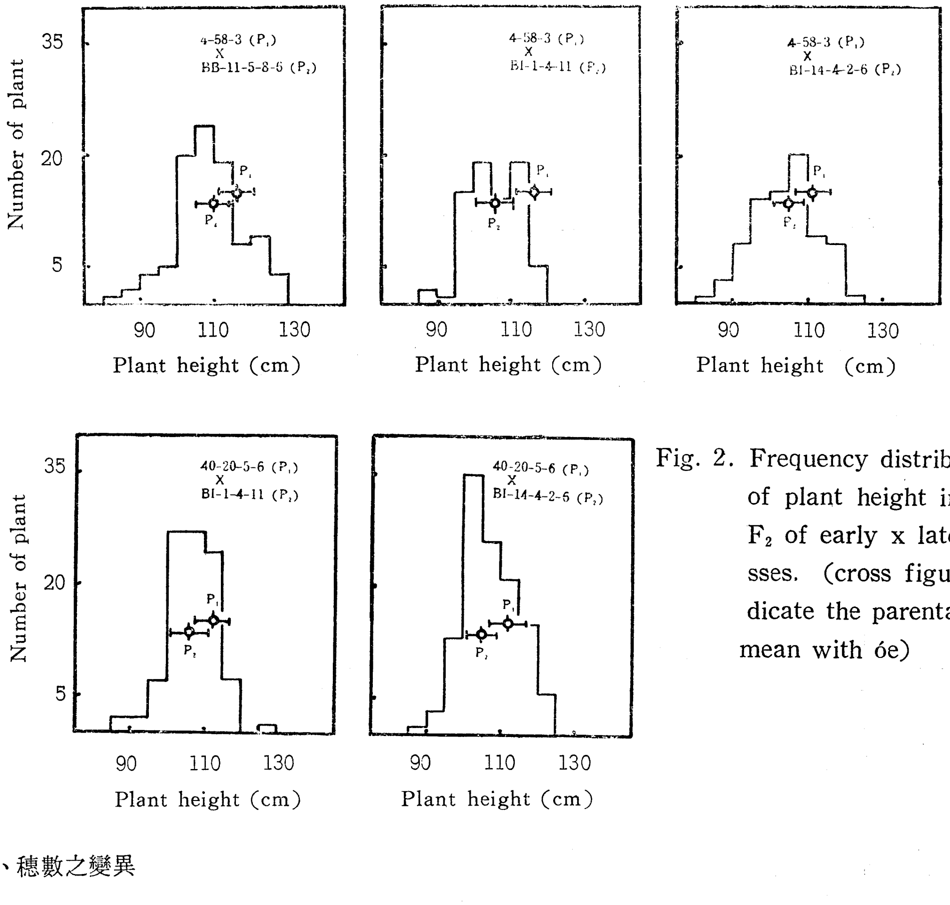



Fig. 2. Frequency distribution of plant height in the $F_2$ of early x late crosses. (cross figures indicate the parental mean with óe)

三、穗數之變異

茲將早晚熟性稻之雜交 $F_2$ 集團及諸親本之變異示於圖3。由圖知諸早熟品系之平均穗數約較晚熟品系多1—2穗，惟經平均值之差異顯著性測驗結果知兩者之差異並不顯著，同時，諸集團本性狀之平均估值亦與早熟親本者相近，總上似提示抽穗期之提早並不影響到稻穗之數目，此結果恰與前人研究之早熟莖因團並不改變原遺傳因子型之分蘖能力的報告相類似（蔡，1968，1974）。

諸$F_2$集團個體穗數之變異頗大，且各$F_2$集團中均有多數個體概以早熟親本爲中心而向正負兩方向超越其兩親本。即在此類雜種集團中，穗數之超越分離現象普遍存在諸$F_2$組合中而爲可資選拔利用之特徵之一。

再由圖3之觀察知諸$F_2$集團本性狀之頻度分布雖尙稱連續，惟圖形之常態與否則視組合之不同而異（表2），提示分蘖能力雖爲品種特性之一，但該性狀之表現暨分蘖之是否有效則易受環境因子所左右，而與鄔（1968b）謂穗數之遺傳現象較株高複雜且對生長環境之反應亦較不穩定之報告大致相符。

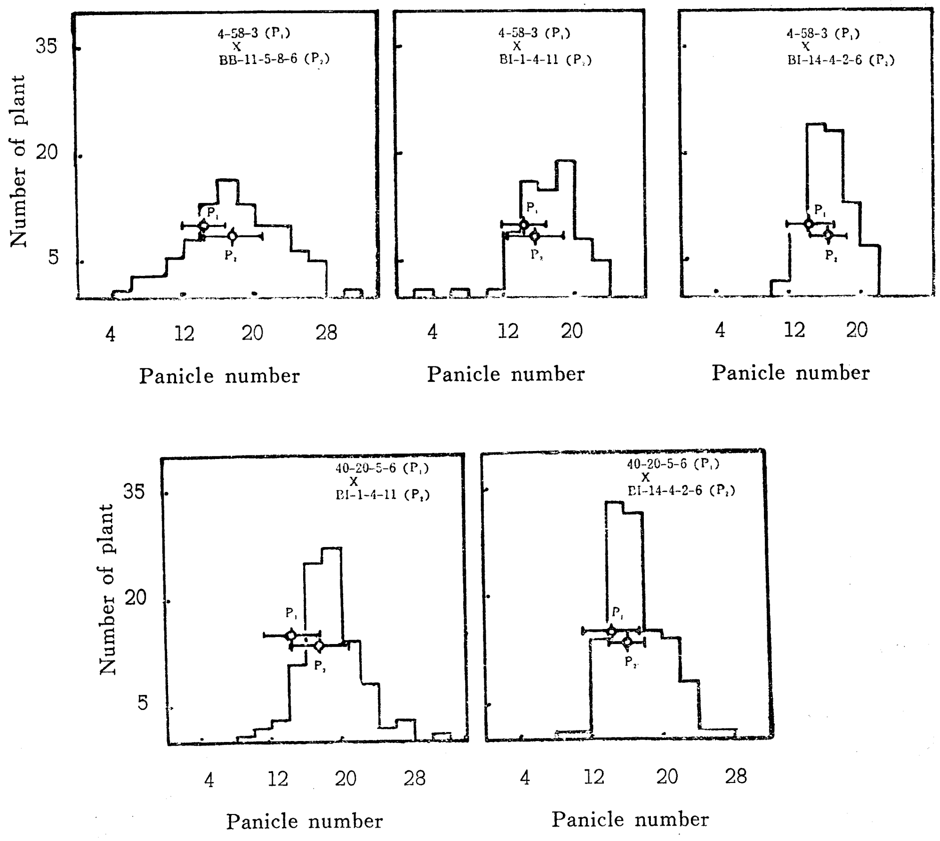



Fig. 3. Frequency districution of panicle number in the $F_2$of early X late crosses.
(Cross figures indicate the parental mean with όe)

四、穗長之變異

由圖4知，諸早熟品系之稻穗的長度均較晚熟品系爲短。其經平均値之差異顯著性測驗知，兩者穗長之差異達極顯著之水準。可知抽穗期愈早者其穗愈短，此表示營養生長期間之長短對幼穗長度之分化具相當之影響力。而此抽穗期早者其穗減短之結果則與 Tsai（1971）之早熟基因團對穗長發生多效作用而減少其大小之觀察相符。

諸 $F_2$ 集團穗數之頻度分布均稱連續，而圖形通呈高峰在左，偏斜在右之右偏態（skew to the right）或正偏態（positive skewness）。

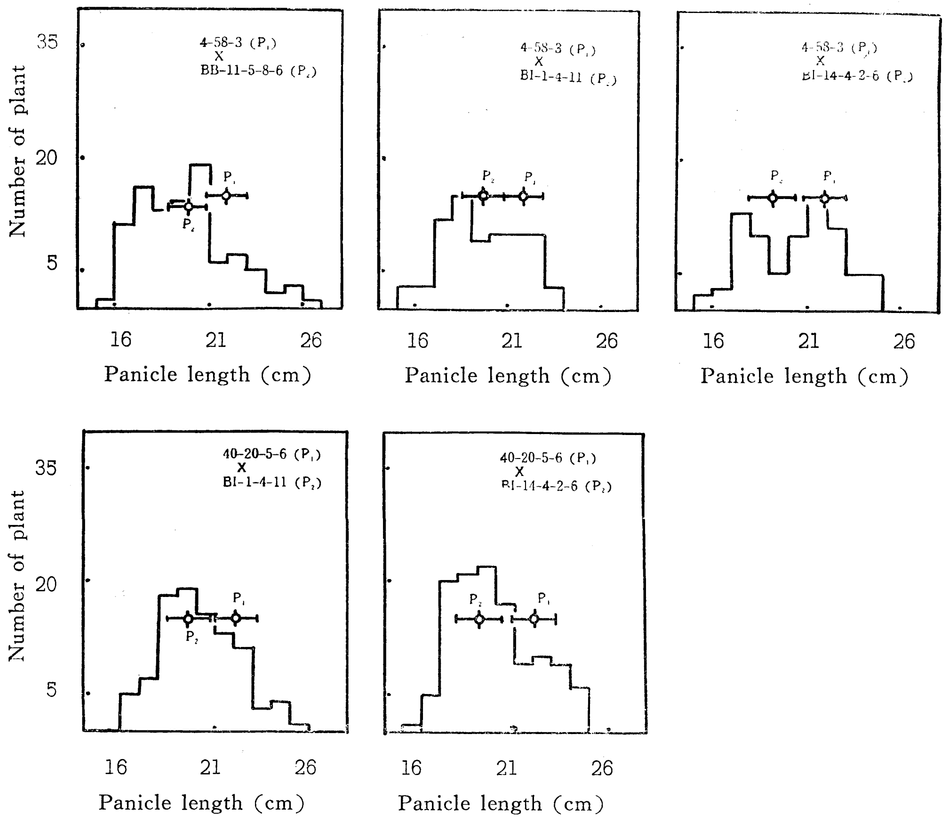
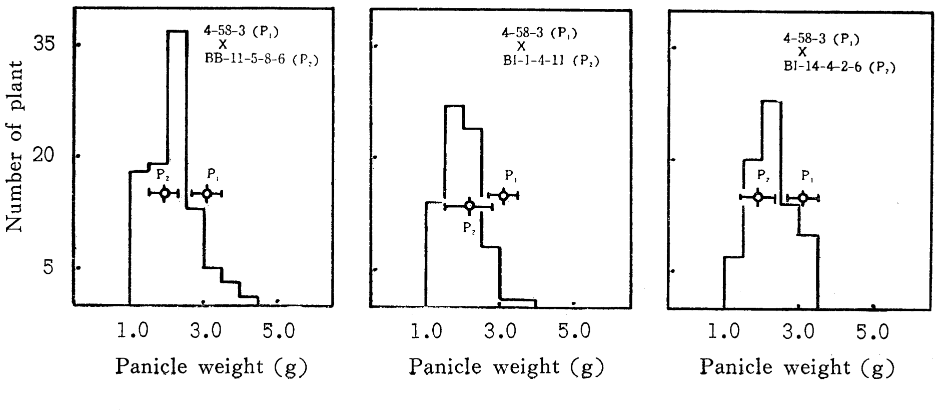



Fig. 4. Frequency distribution of panicle lenght in the $F_2$ of early X late crosses. (Cross figues indicate the parental mean with óe)

五、穗重之變異

早晚熟品系之穗重經平均值之差異顯著性測驗知，兩者差異極顯著，即早熟品系爲穗輕之品系（圖5）。諸 $F_2$ 集團個體本性狀之變異一如米粒蛋白質含量及株高兩性狀，通呈， $F_2$ 集團之個體概集中低親本之平均估值附近；圖形則或爲常態或爲具峰度之近似常態的連續分布。總此，似表示抽穗期之早晚與米粒蛋白質含量，株高及穗重等三性狀間具有某種特殊關係，並暗示米粒蛋白質含量，株高及穗重等三性狀之遺傳模式似較相似。



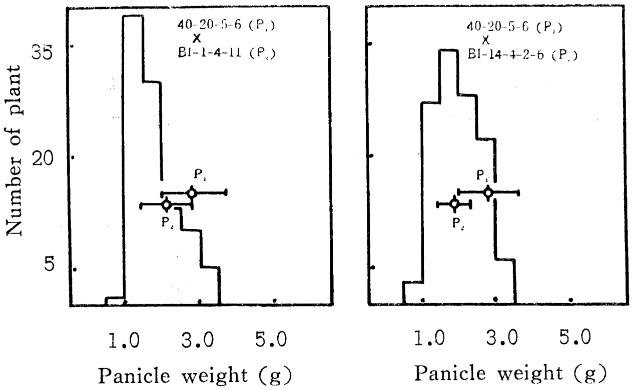
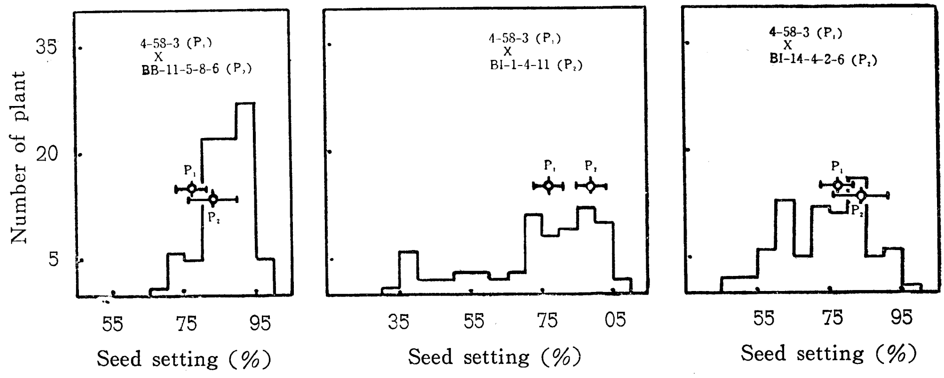



Fig. 5. Frequency distribution of panicle weight in the $F_2$ of early X late crosses (Cross figures indicate-the parental mean with όe)

六、結實率之變異

個體結實率之變異各集團皆有多數個體向負方向的超越其雙親，而諸集團本性狀之頻度分布並呈特異之變異，其圖形或為具峰度，或為具歪度之連續或不連續分布則視組合別而異，此結果恰與前人之觀察結果完全相同（Kawano and Takahashi, 1969）。據 Kawano and Takahashi（1969）由 $F_2$ 結實率特異之變異模式而推論謂：此現象極可能為導致雜種部份 稔性之遺傳體系與其他諸農藝性狀之遺體系有基本上差異存在之故。然因 Kawano and Takahashi（1969）所使用之水稻材料係彼此間之營養生長勢暨生育期的差異極顯著之稻品種，故此結實率特異之解釋尚稱合理。而本研究所使用之水稻材料則僅早熟基因團有差異外，其遺傳背景（genetic background）均屬相同之早熟 iso-genic 系統。故筆者認為本研究中諸集團結實率之特異表現應屬，諸$F_2$集團抽穗期之變異過大，復因本研究水稻材料生殖生長期間天候陰晴不定，淫雨緜緜致影響穀粒充實之故。



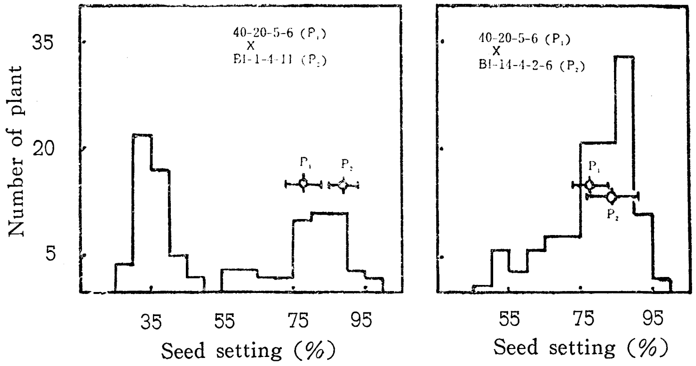




Fig. 6. Frequency distribution of percent seed setting in the $F_2$ of early X late crosses.
(Cross figure indicatethe parental mean with όe)

七、千粒重之變異

由圖 7 知，用爲各雜交組合之親本其千粒重彼此間雖十分近似，但各組合之 $F_2$ 集團則均有正負兩方向超越親本之個體存在，啓示由早晚熟性稻間之雜交，此千粒重性狀有超越分離現象出象。而諸 $F_2$集團之頻度分布圖形似呈高峰在左，偏斜在右之左偏態或正偏態。

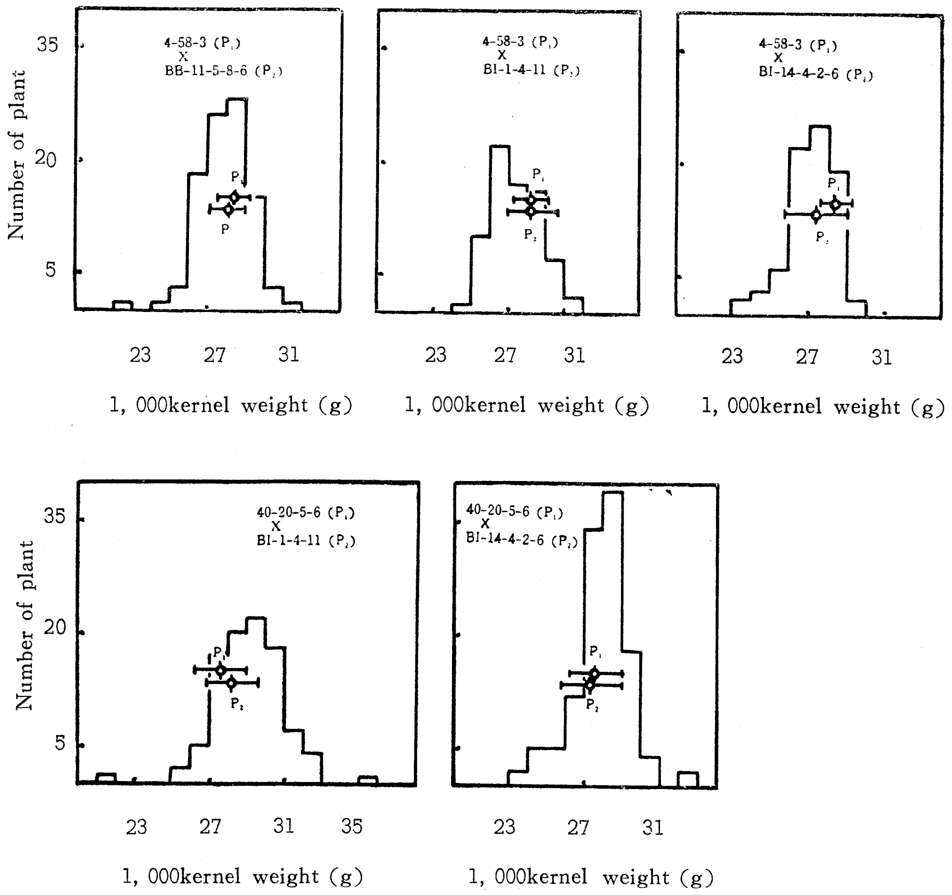



Fig. 7. Frequency distribution of 1, 000 kernel weight in the $F_2$ of early X late crosses. (Cross figures indicate the parental mean with óe)

總上而知，早熟品系爲短稈穗短而輕之高蛋白質含量品系。其產量或雖稍差，但其雜交後代集團之有關產量性狀則皆有或多或少之超離分離現象，且各性狀之分離與抽穗期之關係並不十分絕對影響，提示出吾人可由早晚熟性稻間之雜交集團中可選獲早熟豐產之高蛋白品種。

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# BREEDING FOR HIGN PROTEIN CONTENT IN RICE

## 1. Variation of protein content and other agronomic characters[1] in the cross between early and late maturing japonica rices

by

I. C. Kuo, S. C. Hsieh and S. Y. Song

**Summary**

Genetic variation of protein content and various agronomic traits in the hybrid population of early x late isogenic lines was studied. Variation in protein content and other traits in $F_2$ varied greatly from different cross combinations. From the $F_2$ distribution curve in comparison with that of parental lines, it is assumed that the low protein content is dominant over high protein content. Early maturing is found to be related with high protein content. Further, genetic variations of plant height, panicle number, panicle length, panicle weight, percent seed setting and 1,000 kernel weight were studied with regard to skewness and kurtosis of respective populations.

1.Contributian No. 835 from the Taiwan Aglicultwal Research Instilirte.

# 稻減數分裂期及成熟期施用蔗糖之增產效果[1]

卜瑞雄 陳正昌 黃眞生[2]

**摘要**：本省位於亞熱帶地區，連綿陰雨天往往持續至二個星期甚且更長，尤其在二期作更甚，其間之日照亦常低於 150 克卡／平方公分／天（氣象中心年報1975），因此影響水稻之正常生育而導致產量減產。本試驗乃針對影響水稻光合作用最大之減數分裂期及成熟期，將稻株人工遮陰（90%），以蔗糖噴施稻葉，及以蔗糖溶液灌施，以探討直接施用蔗糖能否補救因光照不足所引起產量減少之部份原因。

供試材料臺農育 A6 號（蓬萊稻），由 Pot 試驗結果，由於本試驗於第二期作執行，於生育後期遭遇低溫及寡日照之影響，結果遮陰並未使退化穎百分比顯著提高，但其結實率，千粒重，登熟率及每欉谷粒產量却大幅降低，因此，蔗糖處理仍未顯出明顯之反應。但嘉農和8 號却有良好之結果，遮陰使退化穎花數增加約54%，蔗糖處理亦有使退化穎花百分比降低之趨勢。

經田間試驗結果顯示：蔗糖葉面噴施及灌漑水施用，對產量構成因素沒有明顯之效果，其小區產量經變方分析結果亦未達顯著之差異。

## 前　言

水稻生育期間因光照不足影響水稻之正常生育，其傷害之程度及形式則視陰雨天發生在水稻生育期之那一時期而不同，例如陰雨天發生在穗芽分化期，則將使抽穗延遲，並使葉及植株增長，最後導致倒伏；若陰雨天發生在減數分裂期，則將抑制穎花之生長與分化，而減少一穗穎花數；若陰雨天發生在成熟期，則影響成熟速度及千粒重等，最後導致產量減少（Matsushima 1972）。爲了補救這些問題，祇好從栽培方法及品種改良著手，品種改良雖是可行的辦法，但是需要長期的時間，且不一定保證能完全解決問題；反之，栽培法改良便成爲一個短期目標的工作。爲了防備穗原始體分化期的植株伸長之敏感性，已有半矮型品種之應用以及「V」字型施肥法，或採用伸長抑制劑等（Takahashi et al. 1961；Huang, 1976），但對於減數分裂期及成熟期的陰雨天，應如何來加以補救則少有報告。

過去曾有許多學者認爲田間太陽光線引起之光合作用（light reaction）所產生的 ADP、NAD-$PH_2$ 已足够推動暗作用（dark reaction）（Arnon et at 1967），譬如樹蔭下嫌光性草本植物，雖然在光線量少之情形下，尙且照樣能生長。此一說法能否應用在水稻，乃是值得懷疑的，因爲成熟期或減數分裂期的日射量與產量有顯著的正相關（Matsushima 1972）。又若在 200克卡/平方公分/天以下光線量時，$CO_2$ 同化量隨線量的減少成拋物線的方式降低，且光線量減少每 5 克卡/平方公分/天，登熟率減少大約 1%（Matsushima 1972）。故日射量減少引起光合作用降低，碳水化合物生成受限制，因此將使穎花的分化和發育停頓，$CH_2O$ 物質貯存之量受限制，結果導致一穗穎花數減少，千粒重亦減輕（Chen 1972）。

針對上述之看法，曾考慮過許多方法：也許可以人工照明來增加光線量，但無論是設備或電費都

1. 臺灣省農業試驗所 研究報告 第 836 號。本試驗承農復會補助經費，文並承劉大江博士斧正，謹此致謝。
2. 臺灣省農業試驗所技佐、技佐及技正。

不經濟；或許可直接噴施 ATP 及 $NADPH_2$ 等之高能化合物，但因分子量太大，能否進入植物體或價錢是否合算，問題仍多；又提高 $CO_2$ 之濃度是另一途徑（Zelitch 1975），但在技術上尚有許多困難。故退一步想，是否可施用蔗糖或葡萄糖等碳水化合物來加予補救，使得稻穗儘量發育？蔗糖分子量爲324，葡萄糖分子量爲180，均能經過氣孔和硬厚的葉面表皮進入植物體內（Franke 1967, Yamada 1965, Kamimura 1964），若由根直接吸收，更加沒有問題，而且蔗糖價格低廉，因此其實用之可能性較大。因此本試驗乃以缽頭（Pot）及田間試驗，將減數分裂期稻株人工遮陰（90%），再由葉面噴洒及灌溉方法施用蔗糖，俾便探討能否補救因遮光所引起的前述後果。

## 材料及方法

供試方料：

使用新育成的優良品系臺農育A6號及嘉農秈8號，蔗糖係本省產白砂糖。

試驗方法：

（1）Pot 試驗

以寒冷紗（ニツト）置蓋稻株（90%遮陰），主稈劍葉葉舌至下一葉舌間距離 0.5cm時起10天，每5天一次，以0、0.3、0.6、0.9g/hill 之蔗糖溶解於 20c.c 之水，以噴槍噴施葉面，及隨灌漑水施用，每處理3欉，於網室內進行，其他栽培法沿用本所慣用法。

（2）田間試驗

亦分葉面噴施及灌漑水施用，每試驗有10個處理，四重複，逢機完全區集法設計，每小區 100欉。10個處理中，1個爲對照無處理（CK），3個爲減數分裂期（主稈葉葉舌至下一葉葉舌間距離爲 0.5cm時）起10天，每5天一次，以50、100、150 kg/ha 之蔗糖施用。3個爲同樣於抽穗期起10天處理者，另3個爲減數分裂期與抽穗期均處理者，其代號如下：

0 ……………………………… 無處理（CK）

M50 M100 M150…………… 減數分裂期處理

H50 H100 H150…………… 抽穗後處理

MH50 MH100 MH150 …… 減數分裂期，抽穗後均處理

田間葉面噴施處理，將規定量之蔗糖溶解於 20c.c/hill 的水分二次噴施。灌漑水施用，將小區以塑膠板隔離以防灌漑水互流，然後將規定量蔗糖施用於每小區，其他栽培法沿用本所慣用法。成熟後，調查（1）株高（2）分蘖（3）退化穎花數（4）二次分枝數（5）一穗粒數（6）千粒重（7）粒幅、粒長（8）結實率（9）登熟率（10）每欉穀粒產量或小區穀粒產量。

## 結果及討論

Pot 試驗調查減數分裂時期施用蔗糖對於二次結實穎花數、二次退化穎花數、退化一次枝梗數、退化二次枝梗數等結果如表一所示。臺農育 A6 號爲蓬萊稻，因遮陰而使幼穗生長緩慢下來，等遮陰十天完畢後繼續生長，此可能蓬萊稻對遮陰有逃避之本能，或由於遮陰過早，以致抑制了幼穗之分化。又因本試驗於第二期作執行，生育後期遭遇低溫及寡日照之影響，結果遮陰雖然未使退化穎百分比顯著提高，但其結實率、千粒重、登熟率及每欉谷粒產量却大幅降低（圖1），因此蔗糖處理亦未有顯出明顯的反應。

本試驗中，嘉農秈8號反而有良好的結果，遮陰使退化穎花數增加約54%，蔗糖處理有使退化穎百分率降低之趨勢（表1），此主要乃由於初次穎花減少退化所致。

田間試驗結果顯示，蔗糖噴施對產量構成因素沒有明顯的效果（表2），其小區產量經變方分析結果亦未達顯著差異，但在蔗糖濃度間却呈顯著差異（表3）。

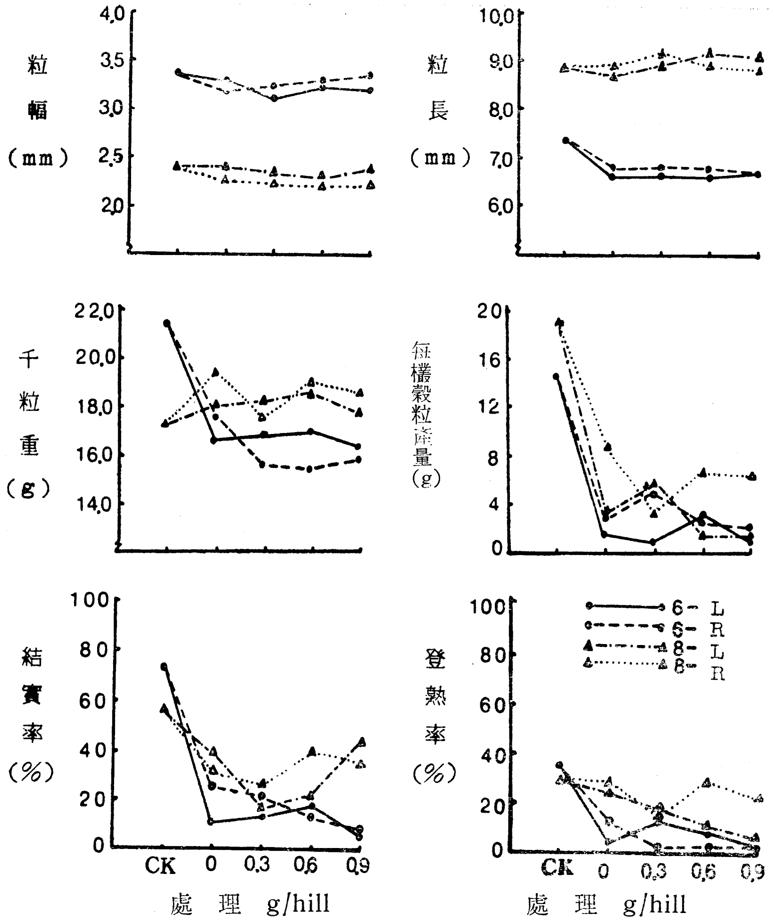


圖 1、減數分裂期遮光十天、施用蔗糖對農藝性狀之消長

(6－L 臺農育A 6號 葉面噴施 8－L 嘉農秈8號 葉面噴施
6－R 臺農育A 6號 灌溉水施 8－R 嘉農秈8號 灌溉水施)

表 1. 減數分裂期遮光十天，施用蔗糖對稻穗退化枝梗、退化穎花數、發育穎花數之影響

| | 處理 | | | 退化枝梗數 | | 退化穎花數 | | 發育穎花數 | | 一穗平均穎花數 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 遮光與否 (90%) | 施用量 g/hill | 施用法 | 一次枝梗 | 二次枝梗 | 二次穎花 (%) | 總數 (%) | 二次穎花 (%) | 總數 (%) | |
| 臺農育A6號 | － | 0 | (CK) | 0 | 6 | 18(12) | 25(17) | 44(30) | 123(83) | 148 |
| | ＋ | 0 | 無 | 0.5 | 6.5 | 13(10) | 23(18) | 34(26) | 106(82) | 129 |
| | ＋ | 0.3 | 葉面噴施 | 0 | 10 | 16(12) | 26(19) | 45(33) | 108(81) | 134 |
| | ＋ | 0.6 | 葉面噴施 | 1 | 11 | 18(12) | 35(23) | 34(23) | 115(77) | 150 |
| | ＋ | 0.9 | 葉面噴施 | 0 | 11 | 20(14) | 34(24) | 39(27) | 108(76) | 142 |
| | ＋ | 0.3 | 灌溉水 | 1 | 8 | 17(10) | 47(26) | 36(20) | 132(74) | 179 |
| | ＋ | 0.6 | 灌溉水 | 0 | 12 | 11( 8) | 32(23) | 27(19) | 109(77) | 141 |
| | ＋ | 0.9 | 灌溉水 | 0 | 4 | 8( 6) | 20(14) | 38(27) | 119(86) | 139 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 嘉農秈8號 | － | 0 | (CK) | 0.5 | 8 | 29(17) | 35(20) | 46(26) | 139(80) | 174 |
| | ＋ | 0 | 無 | 4 | 15 | 55(31) | 129(74) | 6( 3) | 46(26) | 175 |
| | ＋ | 0.3 | 葉面噴施 | 5 | 14 | 50(28) | 150(84) | 5( 3) | 29(16) | 176 |
| | ＋ | 0.6 | 葉面噴施 | 4 | 19 | 49(27) | 142(78) | 6( 3) | 41(22) | 183 |
| | ＋ | 0.9 | 葉面噴施 | 0 | 28 | 60(29) | 102(50) | 19( 9) | 103(50) | 205 |
| | ＋ | 0.3 | 灌溉水 | 4 | 21 | 55(32) | 116(67) | 8( 5) | 56(33) | 172 |
| | ＋ | 0.6 | 灌溉水 | 4 | 8 | 51(25) | 136(66) | 10( 5) | 70(34) | 206 |
| | ＋ | 0.9 | 灌溉水 | 1 | 26 | 55(28) | 93(47) | 27(14) | 106(53) | 199 |

由圖1減數分裂期遮光十天，施用蔗糖對農藝性狀之消長情形看，無論蓬萊稻或秈稻，經遮光處理後，其粒幅、粒長、千粒重、每欉穀粒產量、結實率、登熟率均大幅降低，經蔗糖處理後，臺農育A6號除粒幅、粒長外，其千粒重、每欉穀粒產量，結實率、登熟率有隨蔗糖濃度增加而降低之趨勢。而嘉農秈8號則在灌溉水施 0.6g/hill 蔗糖濃度時，有較高之千粒重、每欉穀粒產量、結實率及登熟率，葉面噴施時各濃度處理間却呈不規則之變化。

## 表 2. 田間葉面及灌溉水施用蔗糖對農藝性狀之影響

| 性狀 ＼ 處理 | | 0 | M50 | M100 | M150 | H50 | H100 | H150 | MH50 | MH100 | MH150 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 葉面噴施 | 株高 (cm) | 100.4 | 96.6 | 98.1 | 98.2 | 100.5 | 98.4 | 98.2 | 97.3 | 97.1 | 96.7 |
| | 每欉穗數 | 11.7 | 10.8 | 11.4 | 11.3 | 12.4 | 11.7 | 11.2 | 10.3 | 12.4 | 13.1 |
| | 每穗粒數 | 102 | 104 | 101 | 98 | 99 | 103 | 102 | 106 | 94 | 99 |
| | 結實率 (%) | 61.8 | 63.5 | 61.4 | 63.3 | 65.7 | 63.1 | 60.8 | 61.3 | 59.6 | 65.7 |
| | 登熟率 (%) | 27.5 | 37.5 | 31.7 | 31.6 | 32.3 | 28.2 | 29.4 | 27.4 | 27.7 | 33.3 |
| | 千粒重 (g) | 22.0 | 22.4 | 21.9 | 22.5 | 22.0 | 22.0 | 22.3 | 22.1 | 21.3 | 22.0 |
| | 粒幅 (mm) | 3.7 | 3.6 | 3.6 | 3.5 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| | 粒長 (mm) | 7.2 | 7.1 | 7.1 | 7.1 | 7.1 | 7.2 | 7.2 | 7.2 | 7.2 | 7.1 |
| | 穀粒產量 (kg/ha) | 2344 | 2501 | 2317 | 2728 | 2413 | 2544 | 2192 | 2496 | 2088 | 2264 |
| 灌溉水施 | 株高 (cm) | 98 | 97 | 95 | 98 | 97 | 97 | 98 | 98 | 97 | 98 |
| | 每欉穗數 | 16.3 | 16.0 | 13.9 | 15.3 | 16.5 | 14.5 | 13.9 | 14.6 | 14.0 | 14.3 |
| | 每穗粒數 | 89.2 | 97.8 | 108.1 | 107.7 | 97.7 | 103.8 | 99.4 | 114.6 | 110.3 | 94.4 |
| | 結實率 (%) | 69.5 | 81.3 | 80.3 | 77.0 | 67.7 | 62.4 | 71.6 | 82.3 | 80.0 | 71.2 |
| | 登熟率 (%) | 62.5 | 38.8 | 38.1 | 38.4 | 37.0 | 30.6 | 36.5 | 40.9 | 40.6 | 42.9 |
| | 千粒重 (g) | 19.1 | 19.6 | 18.1 | 19.1 | 20.4 | 22.2 | 19.3 | 18.3 | 20.9 | 23.1 |
| | 粒幅 (mm) | 3.4 | 3.5 | 3.5 | 3.3 | 3.4 | 3.4 | 3.4 | 3.5 | 3.5 | 3.6 |
| | 粒長 (mm) | 7.0 | 7.0 | 7.0 | 6.9 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| | 穀粒產量 (kg/ha) | 2137 | 2225 | 2012 | 2187 | 2250 | 2050 | 2125 | 2125 | 2125 | 2150 |

表 3. 田間施用蔗糖之株高、分蘗與小區產量變方分析表

| 變因 | 自由度 | 均方 | | | | | |
|---|---|---|---|---|---|---|---|
| | | 葉面噴施 | | | 灌溉水施 | | |
| | | 株高 | 分蘗 | 小區產量 | 株高 | 分蘗 | 小區產量 |
| 區集 | 3 | 14.165 | 11.239 | 1087.092 | 9.88 | 2.8 | 370.63 |
| 處理 | (9) | 7.132 | 0.804 | 544.969 | 3.17 | 1.1 | 207.57 |
| 時期 | 2 | 12.252 | 1.288 | 619.695 | 1.03 | 1.36 | 2.78 |
| 濃度 | 2 | 0.650 | 0.71 | 266.195 | 6.10 | 0.695 | 588.19** |
| 時期 × 濃度 | 4 | 5.097 | 1.05 | 774.986 | 2.97 | 0.903 | 171.53 |
| 施用與否 | 1 | 18.001* | 0.318 | 33.003 | 2.43 | 2.18 | 0.07 |
| 機差 | 27 | 4.178 | 0.889 | 370.851 | 3.30 | 0.97 | 129.421 |
| 總計 | 39 | | | | | | |

*F＝4.3（顯著）　**F＝4.55（極顯著）

由表三變方分析結果看出，田間施用蔗糖，葉面噴施處理與不處理間達顯著差異，而以灌溉水施則處理與不處理間差異不顯著，亦即直接噴洒葉面能矮化株高（表 2）之效果。以灌溉水施蔗糖各濃度間對小區產量呈極顯著之差異，尤以減數分裂期及抽穗後期施用 50kg/ha 之濃度所得小區產量較其他處理產量爲高，其他所有處理間差異均不顯著。

由本試驗結果看出，於減數分裂期若施用蔗糖，能使初次穎花減少退化，尤其此在秈稻方面，其趨勢更明顯。又在田間施用蔗糖效果方面，施用蔗糖能改良一些農藝性狀，使穀粒產量增加。雖經變方分析結果，並未達預期效果，然在蔗糖濃度間却呈顯著差異，此可能是由於所施用蔗糖濃度過低，以致其效果不彰，如能尋求出其有效濃度，並估計其成本是否合理，即可獲得此法之可行性。

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# EFFECTS OF SUCROSE APPLICATION ON GRAIN YIELD IN MEIOSIS AND MATURING STAGES OF THE RICE PLANT[1]

by

R. H. Buu, C. C. Chen and C. S. Huang[2]

## Summary

1. Prolonged rainy weather or low solar radiation is considered one of the causes of low yields of the second crop rice in Taiwan. The total solar radiation during such period commonly falls down to 150 gr. cal/cm$^2$/day or less. Attempts were made to find out whether sucrose application in meiosis and maturing stages corrects the effect of low solar radiation on rice plants.

2. In a pot experiment, about 90% shading by a piece of black cloth for ten days was made during meiosis stage, and the plants were applied with 0, 0.3, 0.6, 0.9 g/hill sucrose through foliage spraying and irrigation water. Inaddition, two field experiments were conducted, one by application of sucrose by foliage spraying and the other in irrigation water through roots. Dssiolve sucrose 50, 100, 150 kg/ha in 20 c.c/hill water, and apply them during meiosis stage, after heading stage and both stages.

3. In the pot experiment an indica rice variety, Chianung Sen 8 showed 54% of degenerated spikelet by the shading treatment. However, sucrose application tended to prevent the spikelets from degeneration. The shading did not cause significant degree of spikelet degeneration in Tainung Yuh A6. Hence the difference in the percentage of degenerated spikelets among the sucrose treatments was not significant. But1,000 grain weight, percentages of seedset and matured grain and grain yield perhill were reduced appreciably.

4. In both field experiments, the analysis of variance of grain yield per plot showed non-significant differences in grain yield among sucrose treatments in meiosis, mat uring stages and both stages.

1. Contribution No. 836 from the Taiwan Agricultural Research Institute.
2. Research Assistant and Senior Geneticist, Department of Agronomy, Taiwan Agriculture Research Institute.

# 開英種鳳梨特性調查研究[1]

林　　國　　明[2]

**摘要**：鳳梨產期短，且甚集中，不同期成熟之果實，其果高、小果數、小果高、小果寬、葉片長、葉片厚、糖度、冠芽葉數、冠芽長、裔芽長、果聲、果柄直徑等，因不同的採果期而有顯著差異。果實重量與小果數、葉片繁茂、裔芽、吸芽等之發育成正相關。植株生長茂盛者，成熟期早，裔芽多，品質佳、糖酸度亦隨之較小。適中，冠芽高之植株，其葉片、裔芽等反而發育差，果實

## 前　　言

臺灣鳳梨以開英種分佈最廣，面積最大，品質好，產量多，管理方便，是目前最好亦最値得推廣之品種。近年來市價偏低，農民在無利可圖的情形下，疏於管理；加以連作土壤問題，致品質漸劣，影響外銷至大。爲增進鳳梨產量與品質，籍以提高農民栽培興趣，爰辦理本研究，期能獲適當改善栽培技術，有助於鳳梨產業之生產。

## 材料與方法

利用本分所開英種鳳梨園，逢機掛牌，由民國64年7月1日開始採收五分成熟度以上果實，至7月31日共採收 306顆，前後分成四週期採收，同時調查各植株果重等26種特性，利用電腦整理，探討不同期成熟果各特性之差異，以及各特性間之相關與迴歸關係。

## 試驗結果

本試驗不同期別採收果實數與果重分佈情形，如圖1及圖2。

圖 1. 採收分佈情形

Fig. 1. The amount of fruit picked at different weeks.

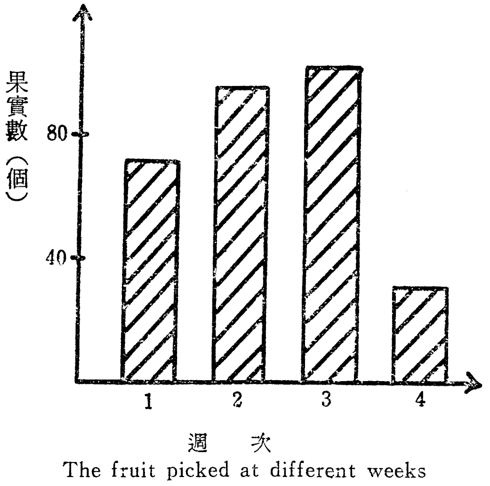
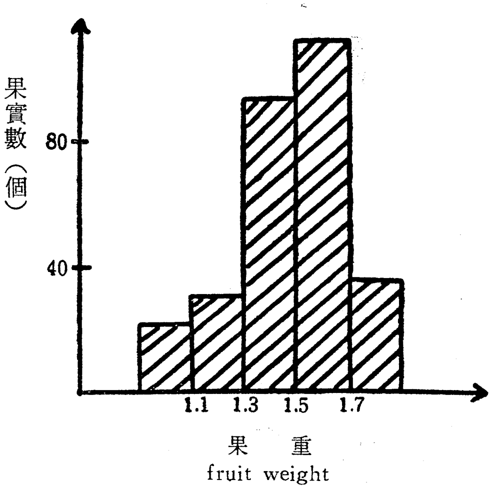



圖 2. 果重分佈情形

Fig. 2. The amount of fruit at different fruit weight.

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2. 臺灣省農業試驗所嘉義農業試驗分所技術員

不同期採收果，各週期之特性平均比較，如表 1.

### 表 1. 各週期之特性平均比較

### Table 1. The comparison means of the characters of the fruit picked at different weeks.

| 項目 character ＼ 不同熟期 week | 第一週 1st | 第二週 2nd | 第三週 3rd | 第四週 4th | 平均 mean | 各週期平均值比較 |
|---|---|---|---|---|---|---|
| 果重 fruit weight (g) | a 1,487.66 | a 1,480.36 | a 1,451.98 | a 1,398.83 | 1,465.10 | 經分析F值不顯著 |
| 果汁重 juice weight (g) | a 697.71 | a 712.09 | a 707.30 | a 693.72 | 705.15 | 經分析F值不顯著 |
| 果圍 fruit round (cm) | a 38.90 | a 38.56 | a 38.53 | a 38.52 | 38.63 | 經分析F值不顯著 |
| 吸芽長 sucker length (cm) | a 34.67 | a 32.34 | a 34.27 | a 35.26 | 33.84 | 經分析F值不顯著 |
| 吸芽數 no. of sucker | a 1.05 | a 0.97 | a 0.92 | a 0.86 | 0.96 | 經分析F值不顯著 |
| 果柄長 peduncle length (cm) | a 12.52 | a 12.79 | a 12.90 | a 13.31 | 12.81 | 經分析F值不顯著 |
| 果高 fruit height (cm) | a 16.24 | ab 16.11 | bc 15.76 | c 15.42 | 15.96 | 第一、二週最大三、四週較小 |
| 小果數 no. of fruitlet | a 151.58 | b 138.41 | c 127.05 | d 112.86 | 135.56 | 第一週最多，二次之第四週最少 |
| 小果寬 fruitlet diameter (cm) | c 2.15 | b 2.36 | a 2.50 | b 2.36 | 2.35 | 第三週最大，第一週最小 |
| 小果高 fruitlet height (cm) | c 2.66 | b 3.07 | a 3.19 | a 3.16 | 3.01 | 第三、四週較大第一週最小 |
| 冠芽葉數 no. of crown leaf | b 82.31 | b 84.89 | b 82.67 | a 90.90 | 84.08 | 第四週最多，其餘不顯著 |
| 冠芽長 crown length (cm) | d 23.41 | c 24.92 | b 25.71 | a 27.02 | 25.00 | 第四週最長，三次之，第一週最短 |
| 冠芽重 crown weight (g) | c 219.31 | c 230.88 | b 255.82 | a 292.59 | 242.05 | 第四週最重，第三週次之 |
| 葉片數 no. of leaf | a 33.35 | a 33.13 | a 32.41 | b 30.17 | 32.67 | 第四週最少 |
| 葉片長 leaf length (cm) | a 84.91 | ab 84.66 | bc 83.60 | c 81.73 | 84.09 | 第一、二週較長，第四週較短 |
| 葉片厚 (mm/100) depth of leaf | a 190.99 | a 193.15 | a 187.31 | b 149.41 | 186.53 | 第四週顯着較薄 |
| 裔芽長 slip length (cm) | a 19.42 | a 18.77 | b 11.02 | b 12.62 | 15.80 | 第一、二週較長 |
| 裔芽數 no. of slip | a 1.43 | a 1.53 | b 0.73 | b 0.79 | 1.17 | 第一、二週較多 |
| 果柄直徑 peduncle diameter (cm) | ab 2.56 | a 2.63 | bc 2.55 | c 2.46 | 2.57 | 第四週較小 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 果聲 fruit voice | b 2.08 | b 2.03 | a 1.68 | a 1.48 | 1.88 | 第三、四週肉聲果較多 |
| 糖度 sugar content | ab 16.80 | a 16.96 | b 16.61 | c 15.43 | 16.66 | 第三週較低，第四週最低 |
| 酸度 Acidity | b 0.416 | b 0.470 | a 0.718 | a 0.703 | 0.560 | 第三、四週較酸 |

註：果聲：肉聲1，柱聲2，鼓聲3

註：採用 Duncan 氏多項變域比較測定法（5%），英文字母相同者表示彼此差異不顯著，不相同者表示顯著。

This is calculated by the method of Duncan's multiple range test at the 5% levels of significance.

一般市面上以肉聲果價錢高，其實果聲與果實水份含量有密切關係，本試驗後期採收者，因雨量較多，大多爲肉聲果，然糖度較之早、中期採收者低。綜觀上述結果，早期採收之植株，株葉繁茂，冠芽小，裔芽多，果柄顯得短粗，本資料若能配合開花期調查，當更完備。

植株不同性狀間之直線相關（Linear correlation），其直線相關係數如表2.

## 表2. 性狀間之直線相關係數

Table 2. The linear correlation of different characters.

註：肉聲果以1代表，柱聲果2，鼓聲果3，例如，果重與果聲之直線相關係數爲 −0.460 **，則果實愈重，肉聲果之機會愈多。

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 果重 fruit wt. | 果重 | | | | | | | | | |
| 葉長 leaf length | 0.532** | 葉長 | | | | | | | | |
| 葉數 no. of lear | 0.260** | 0.133* | 葉數 | | | | | | | |
| 小果數 no. of fruitlet | 0.697** | 0.391** | 0.245** | 小果數 | | | | | | |
| 冠芽高 crown height | -0.051 | -0.040 | -0.228** | -0.283** | 冠芽高 | | | | | |
| 冠芽葉數 no. of crown leaf | 0.318** | 0.054 | -0.107 | 0.219** | 0.216** | 冠芽葉數 | | | | |
| 果柄寬 peduncle diameter | 0.671** | 0.380** | 0.255** | 0.484** | -0.026 | 0.257** | 果柄寬 | | | |
| 吸芽數 no. of sucker | 0.389** | 0.250** | 0.176** | 0.349** | 0.029 | 0.121* | 0.265** | 吸芽數 | | |
| 裔芽數 no. of slip | 0.379** | 0.335** | 0.208** | 0.397** | -0.193** | 0.069 | 0.420** | 0.164** | 裔芽數 | |
| 醣度 ugar content | -0.302** | -0.121* | 0.227** | -0.153** | -0.159** | -0.353** | -0.164** | -0.204** | -0.107 | 醣度 |
| 果聲 fruit voice | -0.460** | -0.241** | -0.164** | -0.153** | -0.111 | -0.299** | -0.351** | -0.243** | -0.131* | 0.312** |

＊ 5%差異顯着　　＊＊ 1%差異顯着。

＊ 5% levels of significance　　＊＊ 1% levels of significance

由表二可看出，一果之大小，與植株之生長勢，有極明顯之正相關，然若過分的營養生長，或水份含量過多，易導至糖度降低，此與施肥及日照甚有關係，如能適當控制株行距及施肥，想必能獲得大且甜的果實。至於田間優良母樹之選拔，除了注意單冠，冠芽小、果大、果柄短而粗等特性之外，若能注意到冠芽短且葉片數多者，或許能緩和後代芽體之不足。本特性若能進一步分析兩特性間之曲線關係及淨相關，將更能洞澈鳳梨植株之特性。

各特性之變異係數（Coefficient of Variation, C. V. ）如表3.

表3. 各特性變異係數值

Table 3. The Coefficient of Variation (C. V. -value) of each character.

| 特性項目 character | C. V. 値 | 特性項目 character | C. V. 値 | 特性項目 character | C. V. 値 |
|---|---|---|---|---|---|
| 果重 fruit wt. | 15.18 | 冠芽重 crown wt. | 16.9 | 吸芽數 no. of sucker | 56.25 |
| 果汁重 juice wt. | 15.43 | 冠葉數 no. of crown leaf | 10.38 | 裔芽數 no. of slip | 106.84 |
| 果圍 fruit round | 4.69 | 葉寬 leaf diameter | 7.46 | 果柄長 peduncle length | 18.50 |
| 果高 fruit height | 8.08 | 葉片長 leaf length | 5.60 | 果柄寬 peduncle diameter | 9.34 |
| 小果數 no. of fruitlet | 18.34 | 葉數 no. of leaf | 12.27 | 果聲 fruit voice | 42.02 |
| 小果高 fruitlet height | 6.64 | 花腔深 depth of flower cavity | 16.19 | 醣度 sugar content | 6.42 |

園藝作物，一般多採用營養體繁殖，異於一般短期作物。現一品種假定來自同一母株，其變異之大小若非因於突變，則必受之於自然界之環境變異，鳳梨爲單果實植株，變異係數可爲一般田間選拔之參考，變異係數小者，後代之複現率可能亦高。若能做後代裔芽繁殖比較測定，則可測其價值性。

## 討論

中國園藝學會出版之臺灣鳳梨之研究內，提及拓植佐次郎等[1]以沙勞越種調查鳳梨諸性狀與果重之相關關係，以及各特性之變異係數，其與本文有極大類似結果，祇是拓植氏認爲最長葉長，吸芽數，裔芽數等與果實重量無相關關係，而本調查裡有顯著之正相關，可能因採用的品種，及調查之時期與方法不同而有差異，本文採用開英種，葉長以取任三方向三葉長之平均。

於本試驗裡，果柄長與果柄寬呈極顯着負相關，果柄細長者則果實小，冠芽高，吸裔芽都少，故選拔優良種苗母株時，短且粗的果柄，不失爲供參考的資料。至於果聲與果汁含量，呈極顯著的負相關，而與糖度呈正相關，鼓聲果果汁含量少，風味差，肉聲果糖度低且不耐運輸與貯藏，杜聲果則適其中。果實大，枝葉發育良好的植株，吸芽及裔芽數亦多，而早，中期採收者，其枝葉顯得較茂盛，裔芽數多，糖度高，冠芽小，風味佳。以現一般之栽培法，吸芽太少，影響隔年收成，植株亦因之容易倒伏，果實日燒更趨嚴重，施肥，除草等工作甚多不便，且由於吸芽長出之遲早，開花期不一，易形成多果，汁酸甚少經濟價值。故可先淘汰不良種苗，再施用合理肥料因素，期使植株發育興旺、達到刺激吸芽早日形成與成長之目的。

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# STUDIES ON THE CHARACTERISTICS OF SMOOTH CAYENNE PINEAPPLE[1]


by

Kuo-ming Lin[2]



## Summary

In the study of three hundred and six stocks of Caynne pineapple, we picked over-half-matured fruit at four different weeks from the beginning, and at the same time check the fruit wt., sound of fruit etc., twenty-six characters of each stock, and study the coef. of linear correlation of each character, and the differenes of each character at different period of maturity.

The fruit weight and the number of fruitlet, flourish of leaves, development of slip and sucker etc. are positively correlated. The fruit sounded like knocking one's arm have more juice than those which sounded like knocking wooden column, but the fruit sounded like knocking a wooden column have higher sugar content. The slenderer the peduncle is, the smaller the fruit is, the higher the crown is, the less the amount of the sucker and slip. The leaves of the plant picked at earlier or middle period look more flourished, especially with more higher sugar content, smaller crown, and delicious taste.


1. Contribution No. 837 form the Taiwan Agricultural Research Institute.
2. Research assistant, Chia-yi Agricultural Experiment Station, TARI.

# 期作與秈稉二型水稻品種之生育相研究[1]

邱 善 美[2]

**摘要：**本試驗在探討瞭解稻生產過程中影響高產的生理過程，形態特徵，以明瞭不同期作對秈稉二型水稻品種產量的高低是否由於品種的本質或其他因素或產量組成成份，以供今後改良二期作品種選拔之參考，茲將試驗結果摘要如下：

不同類型品種間期作對株高伸長的過程有極大的差異，半矮性秈稻品種或植株較矮的稉稻品種（如 Todorokiwase）一期作株高的伸長速度，以生育前期大於生育後期，高稈的稉稻品種則生育後期大於生育前期，但以抽穗期達最高峰。二期作，二型品種株高的伸長速度，均以生育前期大於生育後期，但所受環境的影響稉稻大於秈稻。

在第一期作之環境下，品種間初期分蘗數的增加影響甚微，移植後 5～6 週間為分蘗最旺盛時期，分蘗期約可延續一個月之久。二期作分蘗的增加趨勢與第一期作不相同，分蘗期短促為其一大特色但穗數仍以秈稻品種較稉稻品種多。

就供試 6 個品種言，一期作之稈高均高於第二期作，穗數亦以第一期作較第二期作多，但稉稻較秈稻差異大，（如高雄 64 號，一二期作差異 27% 為最大，次為 Todorokiwase 12.5%，新竹矮脚尖4.1%，而嘉農秈11號無差異）。一穗粒數一二期作之差異以 Todorokiwase 為最大（24.8%），次為臺農38號，高雄64號，新竹矮脚尖，分別為 12.4，10.5，8.4%，以嘉農秈11號之3.2%最低。千粒重以新竹矮脚尖之差異最大（15.2%），嘉農秈11號較少（4.7%）。

一二期作單位面積稻穀產量的差異，以 Todorokiwase 最大（減產30%）臺農38號及高雄64號次之（分別減產21.3及21.5%）新竹矮脚尖及嘉農秈11號居三（分別減產 17.4及15.7%）以花蓮18號減產8.3為最少。

## 前 言

近年來，如何提高第二期稻作的產量，已為稻作工作者極為關心及急欲覓求方法以解決的一個問題。一二期作單位面積稻穀的產量，據統計不論為秈稻或稉稻，後者均較前者為低。究其原因，一般咸認為是氣象因子，土壤問題，病蟲害，品種及栽培技術（李，湯1963，鄔等1975）等諸方面所導致的結果。這方面沈與魏（1970）報導，本省北中南部的氣候變化迥異，水稻品種的農藝性狀及產量對各地區的氣象因子的反應不相同所導致的結果。湯等（1975）以蓬萊稻區試驗之資料，分期作別作綜合分析，也顯示品種間對環境的反應殊不一致，稻因子型對一二期作截然不同的環境的適應性可能不是居於完全相同的遺傳機構。就稻生理方面著手研究者，如 Jennings（1964）認為在熱帶地區，直立性的稻葉能吸收較多的陽光，因而產量高，Monteith（1969）則認為多雲的氣候，直立性的葉片對光合作用並無好處。松島省三等報告，在密植栽培情況下，以葉片角度小而直立者為佳，疏植區，葉片角度的大小對產量沒有關係。Nickell（1959）作大麥產量組成或分與穀產量之關係試驗，認為增加大麥的分蘗並不一定增加產量。但松島氏以稻為試驗材料所得結果，適為相反。

綜觀以上各學者試驗結果，欲達到稻穀高產，必須使品種，環境及栽培管理方法相互支配，密切

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1. 臺灣省農業試驗所研究報告第 838 號。本試驗承國家科學委員會之獎助，謹此致謝。

2. 臺灣省農業試驗所技士。

配合，方能達到相乘的效果。而瞭解生產過程中影響高產量之生理過程，形態諸特性，以探究其產量高低的原因爲首要工作。本研究之目的乃據以上的觀點，就目前秈稉二型水稻品種中選出具有不同型態特性的品種六種（包括秈稻二品種，稉稻四品種）。爲試驗材料，藉以研究在不同的期作環境下，其產量的高低是由於稻品種之本質或產量組成成份，俾作爲今後改良第二期作稻品種選拔時的參考。

## 材料及方法

一、試驗材料：供試驗品種有 Todorokiwase（稉稻，早熟，多穗），臺農 33 號，高雄64號，花蓮18號（稉稻，晚熟，穗重）及秈稻品種新竹矮脚尖，嘉農秈11號等 6 個品種。

二、試驗設計：採逢機區組設計，重複四次，單本植，十行區，每行20株，行株距 25×20cm，小區面積10M²，秧田及本田管理方法均按本所慣行方法行之。

三、性狀調查及方法：

（一）株高及分蘖：每重複逢機取樣十個體併編號掛牌移植後20天開始調查，而後每週調查一次，至齊穗期後停止。

（二）乾物重：每星期調查一次，每重複逢機採取 5 個體連根拔起洗淨後置於烘箱內以 80°C 高溫烤乾二天後測其重量。

（三）抽穗期：第一穗抽穗當日。

（四）稈高：成熟時地上部之高度。

（五）穗長：由穗頸至穗尖之長度。

（六）每穗粒數：用上同一材料調查每穗粒數。

（七）千粒重：以計數器取出充實穀粒千粒以測定其重量。

（八）結實率：（結實粒數／總粒數）×100表示之。

（九）藁重：5 M²之乾草重。

（十）穀重：100叢之乾穀重。

## 結果及討論

一、期作對不同類型水稻品種株高伸長的影響：就供試不同類型六個水稻品種，經每隔 7 天調查株高伸長結果如圖 1，第一期作的結果，發現品種間株高伸長的過程有極大的差異，半矮型秈稻品種如嘉農秈11號，新竹矮脚尖，株高的伸長速度以生育前期大於生育後期，而最高的伸長速度也發生於生育前期，而不是生育後期。反觀稉稻品種如臺農33號或高雄64號，株高的伸長速度，生育前期小於生育後期，換言之株高之伸長多集中於抽穗期前後，而以抽穗期達到最高，此種現象與半矮性秈稻品種株高伸長的速度完全不同。其次如 Todorokiwase 稈高在 100 cm 左右的品種，其株高之伸長速度與半矮性秈稻品種甚爲近似。第二期作插秧後正值高溫多照，植株生育甚爲旺盛，在此種自然環境下，株高的伸長速度大異於第一期作，不論其爲秈稻品種或稉稻品種，株高伸長的速度，生育前期都大於生育後期。若以品種類型間來比較，秈型品種如新竹矮脚尖及嘉農秈11號，生育前期株高的伸長速度都大於稉稻品種，但在抽穗期株高伸長的速度則以新竹矮脚尖（20.9%）較其他供試驗品種都大。由此觀察結果，株高伸長的一般趨勢來說，不同的環境可致使株高的伸長過程有所差異，但受影響最大的爲稉稻品種，對秈稻品種之影響較弱。

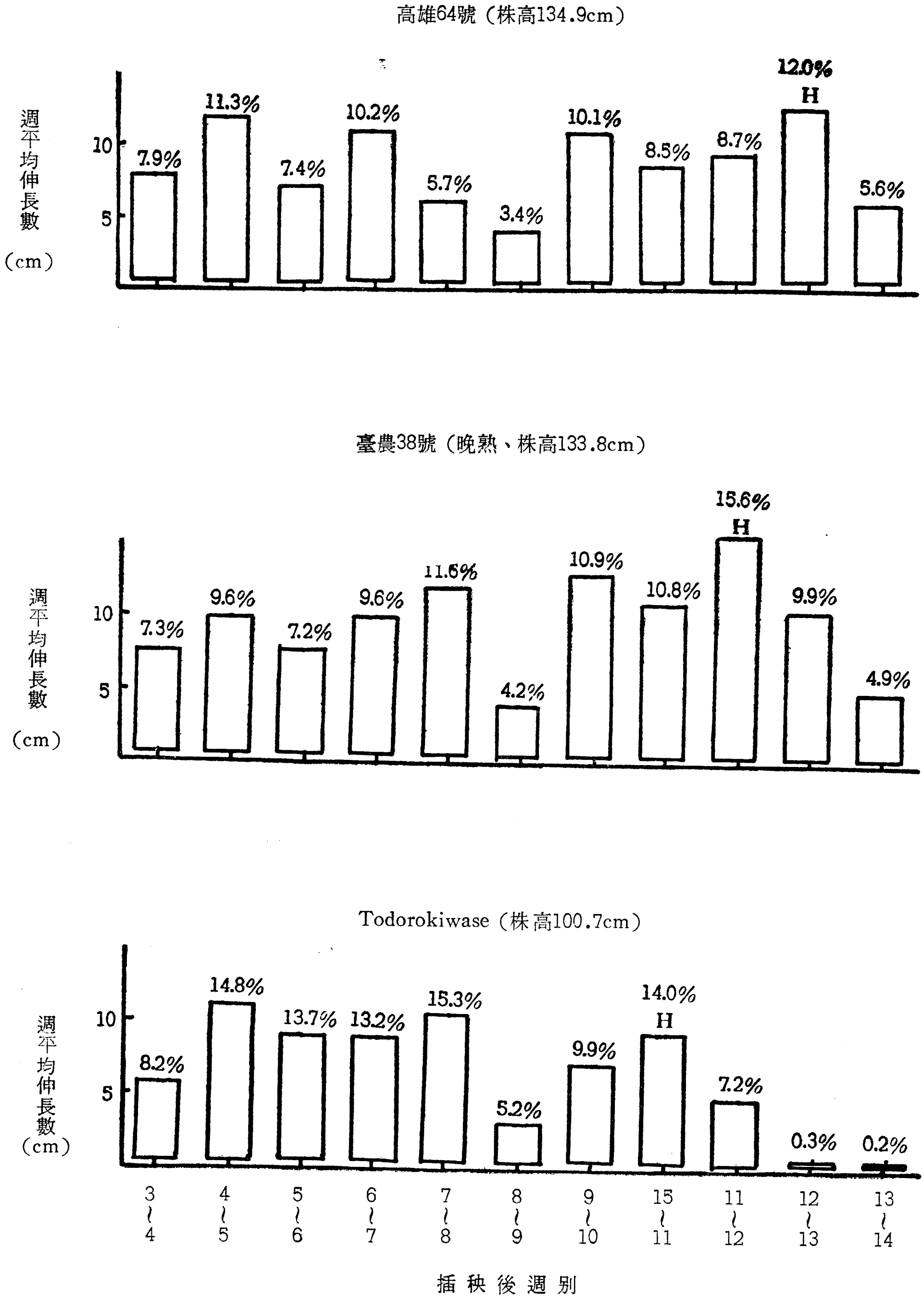


圖1　A. 期作對不同類型水稻品種株高伸長過程之影響（第一期作）

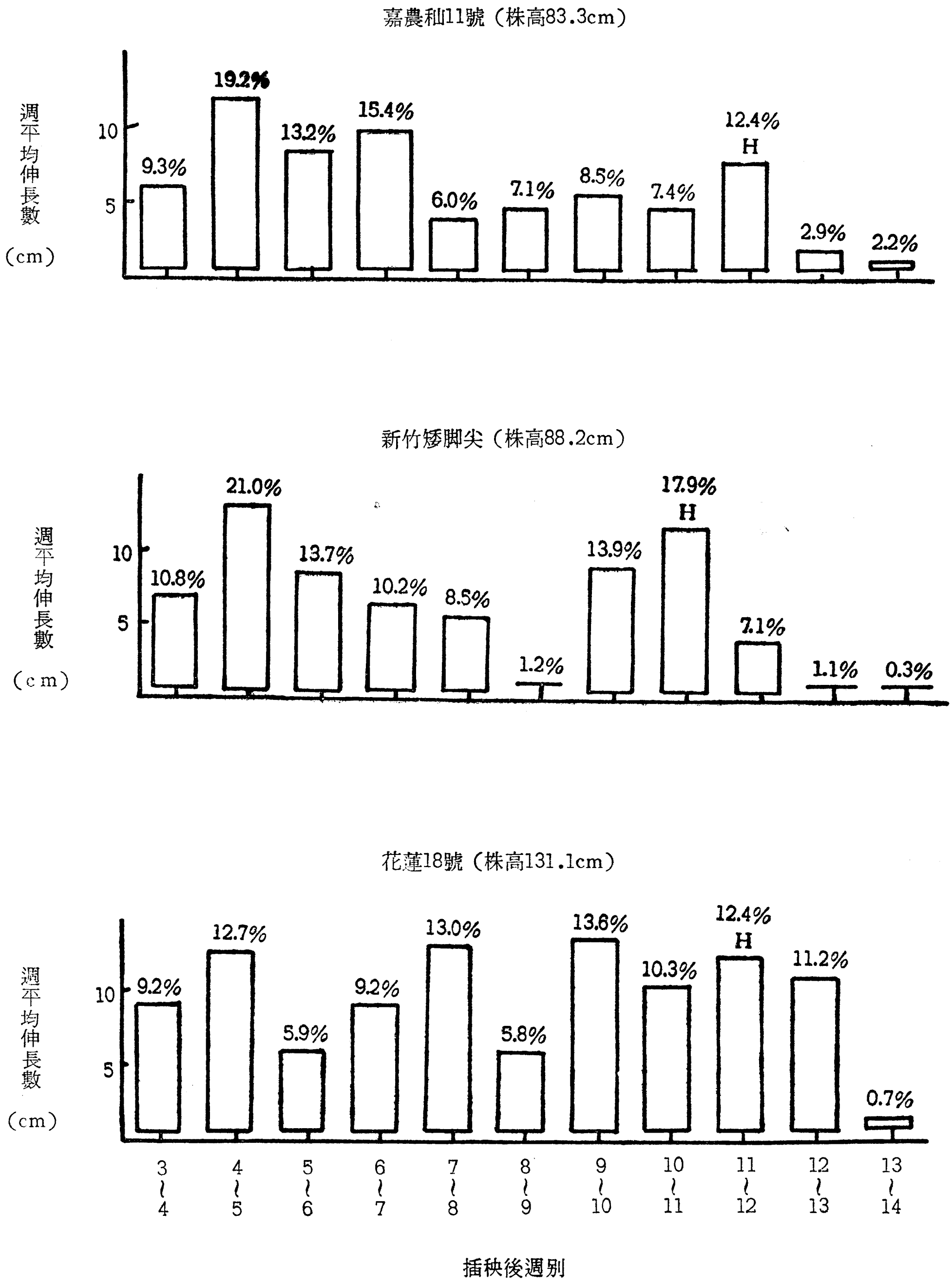


圖1　B. 期作對不同類型水稻品種株高伸長過程之影響（第一期作）。

二、期作對不同類型水稻品種分蘗數消長之影響：

不同類型水稻品種間分蘗數的消長情形如表1及表2。觀表1，第一期作分蘗始期大約在3月底，初期分蘗數之增加品種間差異甚微，隨後由於氣溫的逐漸上升，分蘗數隨之增多，就一般分蘗消長來說，插秧後第5週至第6週爲分蘗最旺盛時期，但品種間有明顯的差異，如Todorokiwase，新竹矮脚尖，嘉農秈11號最旺盛分蘗之時期約可延續一個月（自4月下旬至5月上旬），高雄64號則集中於4月中旬至下旬，6月後分蘗數甚微。同樣的情形也發生於臺農38號及花蓮18號經由上觀察結果可知，大凡多穗型的品種，行分蘗的時間約有一個月之久，且大部分的分蘗數均集中在此時間產生，穗重型的品種則不然，分蘗數的增加爲期較短，雖然以後分蘗數仍在增加但爲數極微，此種現象與多穗型品種分蘗數的消長趨勢完全不同。觀表2，第二期作分蘗數消長的趨勢與第一期作又不同，供試六個品種中Todorokiwas，大部份的分蘗均產生於9月13日以前，但其後的2個星期仍有部份的分蘗出現，反觀其他的五個品種自9月13日以後即不再行分蘗，但總分蘗數仍以多穗型的品種多於穗重型的品種。此可能意味著，第二期作穗數減少者，可能是由於分蘗時間的過短（如穗重型品種）所

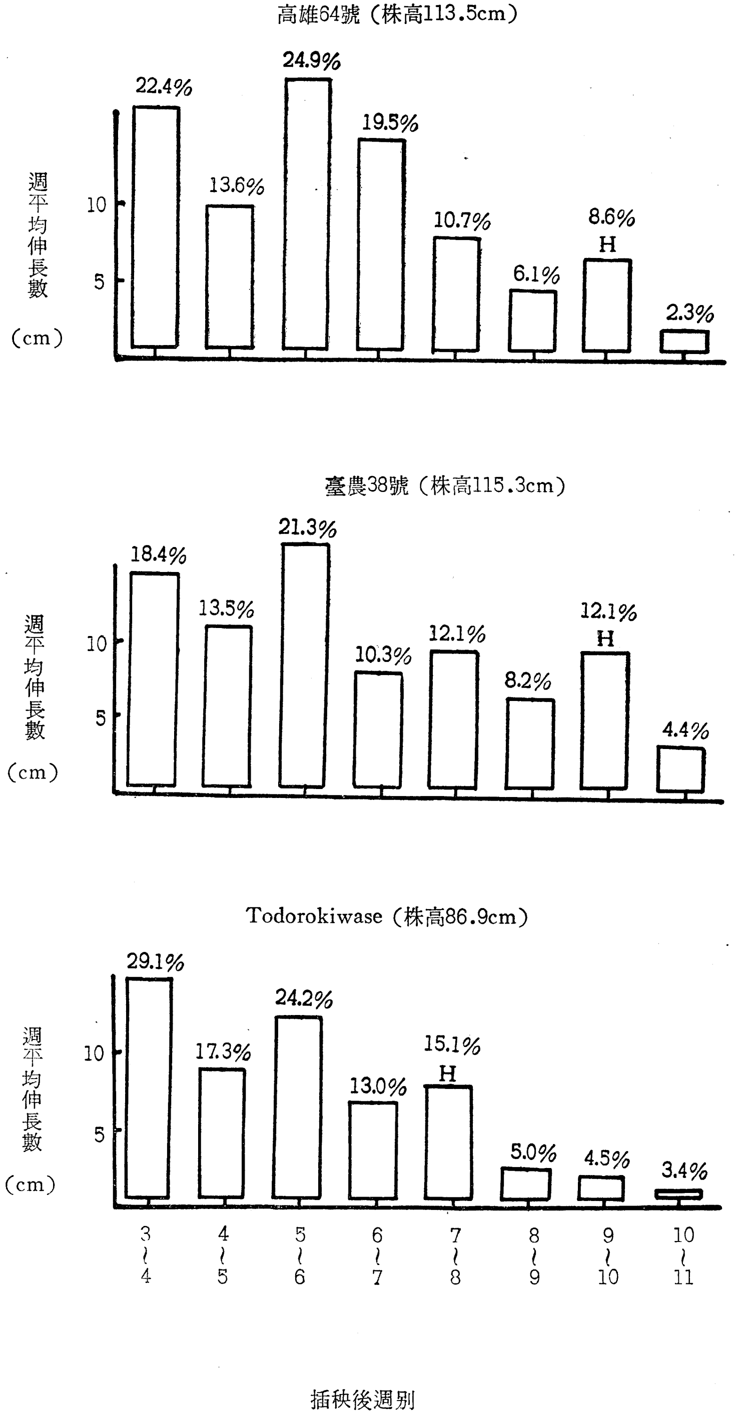


圖1 C.　期作對不同類型水稻品種株高伸長過程之影響（第二期作）

致，但如嘉農秈11號，雖處於同一環境下，分蘖數並未見減少，所以如能覓得某種品種具有在高溫下發揮分蘖潛力（如嘉農秈11號）或在高溫下能迅速達到其分蘖力，對二期稻穀的增加有很大的俾益。

三、期作對不同類型水稻品種全乾物重之影響：供試驗品種全乾物重每週的增加率如圖2。第一期作生育初期，全乾物重以新竹矮脚尖較其他品種增加爲速。但自插秧第7週及第8週後，其情形即

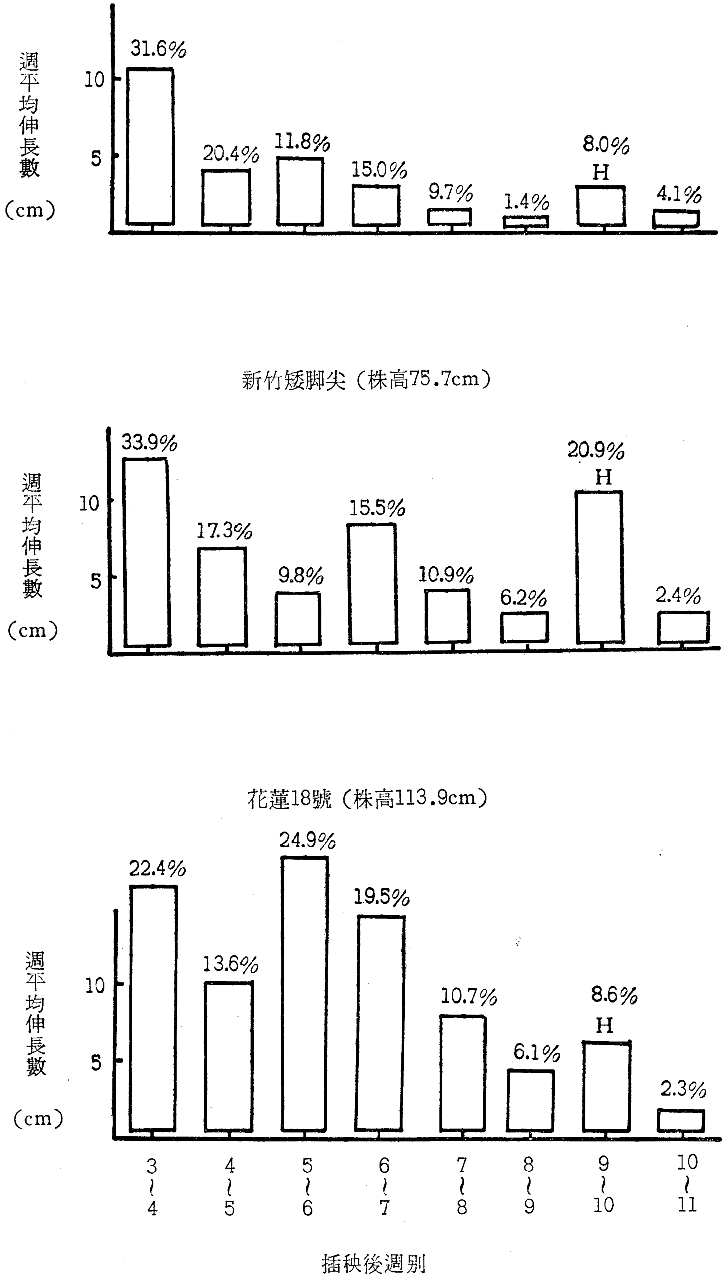


圖1 D.期作對不同類型水稻品種株高伸長過程之影響（第二期作）

## 表1. 不同類型稻在第一期作環境下分蘖數之消長

| 品　　　種 | 項　　　目 | 調查日期 8/Ⅳ | 15 | 22 | 29 | 6/Ⅴ | 13 | 20 | 穗　數 |
|---|---|---|---|---|---|---|---|---|---|
| Todorokiwase | 分　蘖　數 | 2.4 | 4.6 | 6.5 | 11.9 | 16.8 | 21.1 | 18.7 | 18.1 |
| | 增　減　數 | 2.2 | 1.9 | 5.4 | 4.9 | 4.3 | −2.4 | | |
| | 百　分　比　(%) | 11.37 | 21.80 | 30.81 | 56.40 | 79.62 | (100) | — | |
| 臺　農　38　號 | 分　蘖　數 | 1.7 | 3.9 | 5.4 | 10.0 | 12.2 | 13.6 | 13.3 | 11.6 |
| | 增　減　數 | 2.2 | 1.5 | 4.6 | 2.2 | 1.4 | −0.3 | | |
| | 百　分　比　(%) | 12.50 | 28.68 | 39.70 | 73.53 | 89.71 | (100) | — | |
| 高　雄　64　號 | 分　蘖　數 | 2.2 | 4.3 | 5.7 | 11.5 | 13.2 | 14.4 | 13.8 | 12.9 |
| | 增　減　數 | 2.1 | 1.4 | 5.8 | 1.7 | 1.2 | −0.6 | | |
| | 百　分　比　(%) | 15.28 | 29.86 | 39.58 | 79.86 | 91.66 | (100) | — | |
| 花　蓮　18　號 | 分　蘖　數 | 1.6 | 4.0 | 5.1 | 9.9 | 12.6 | 13.7 | 14.2 | 12.5 |
| | 增　減　數 | 2.4 | 1.1 | 4.8 | 2.7 | 1.1 | 0.5 | | |
| | 百　分　比　(%) | 11.27 | 28.17 | 35.92 | 69.72 | 88.73 | 96.48 | (100) | |
| 新　竹　矮　脚　尖 | 分　蘖　數 | 1.9 | 4.6 | 6.3 | 13.1 | 16.2 | 17.5 | 18.2 | 14.8 |
| | 增　減　數 | 2.7 | 1.7 | 6.8 | 3.1 | 1.3 | 0.7 | | |
| | 百　分　比　(%) | 10.44 | 25.27 | 34.62 | 71.98 | 89.01 | 96.15 | (100) | |
| 嘉　農　秈　11　號 | 分　蘖　數 | 2.4 | 4.4 | 6.4 | 13.50 | 17.0 | 22.8 | 21.9 | 16.3 |
| | 增　減　數 | 2.0 | 2.0 | 7.1 | 3.5 | 5.8 | −0.9 | | |
| | 百　分　比　(%) | 10.53 | 19.30 | 28.07 | 59.21 | 74.56 | (100) | — | |

有變化，Todorokiwase 之增加率(10.82%) 超過新竹矮脚尖 (9.67%) 1.15%，隨後嘉農秈11號急起直追一路領先其他品種。如以各別品種來比較， Todorokiwase 於插秧後 11 週增加率達最高 (24.3%) ，其次爲第10週及第 8 週分別增加 16.9%及10.82%，自12週以後各週全乾物重的增加率頗少，至第15週全乾物重之增加率複再提高。臺農38號全乾物重最高增加率發生於移植後的第10、11及12週，分別爲18.1%、16.6%及19.2%。高雄64號則發生於移植後的第11週 (26.3%) 次爲第12週 (15.9%) 。花蓮18號與高雄38號相似，最高增加率亦發生於移植後的11及12週，其增加率分別爲25%及13%。新竹矮脚尖與嘉農秈11號全乾物重之最高增加率稍有不同，前者發生於移植後第11週 (20.6%) 次爲第10週 (16.2%) ，而嘉農秈11號則發生於第12週 (32.7%) 次爲第11週 (26.2%) 。

第二期作，稻生育初期氣溫高，全乾物重各週之增加率均較第一期作爲高，最高增加率發生的時期，除品種高雄64號發生於移植後第 8 週外，其他的品種均發生於第 9 週。又試觀各品種之抽穗期分析，Todorokiwase 第一期作於 5 月23日抽穗(移植後第10週)。第二期作於 9 月29日抽穗 (移植後第 8 週)臺農38號抽穗期，第一期作 6 月 3 日(移植後第11週) ，二期作10月 9 日 (移植後第 9 週) ，高雄64號及花蓮18號，第一期作之抽穗期均爲 6 月 9 日 (移植後第12週) ，第二期作分別爲10月13日 (

表2. 不同類型稻在第二期作環境下分蘗數之消長

| 品種 | 項目 | 調查日期 | | | | | | | 穗數 |
|---|---|---|---|---|---|---|---|---|---|
| | | 30/Ⅶ | 6/Ⅸ | 13 | 20 | 27 | 4/Ⅹ | 11 | |
| Todorokiwase | 分蘗數 | 4.7 | 8.6 | 13.6 | 14.8 | 15.0 | 14.4 | 15.9 | 14.2 |
| | 增減數 | | 3.9 | 5.0 | 1.2 | 0.2 | −0.6 | 1.5 | |
| | 百分比（%） | 31.33 | 57.33 | 90.67 | 98.67 | (100) | — | — | |
| 臺農38號 | 分蘗數 | 5.9 | 10.3 | 13.3 | 12.1 | 11.1 | 11.2 | 10.9 | 10.7 |
| | 增減數 | | 4.4 | 3.0 | −1.2 | −1.0 | 0.1 | −0.3 | |
| | 百分比（%） | 44.36 | 77.44 | (100) | — | — | — | — | |
| 高雄64號 | 分蘗數 | 5.4 | 8.6 | 11.3 | 10.4 | 10.3 | 10.0 | 10.2 | 9.4 |
| | 增減數 | | 3.2 | 2.7 | −0.9 | −0.1 | −0.3 | 0.2 | |
| | 百分比（%） | 47.79 | 76.11 | (100) | — | — | — | — | |
| 花蓮18號 | 分蘗數 | 5.8 | 9.5 | 12.7 | 11.2 | 12.2 | 11.7 | 11.7 | 11.2 |
| | 增減數 | | 3.7 | 3.2 | −1.5 | 1.0 | −0.5 | 0 | |
| | 百分比（%） | 37.80 | 74.80 | (100) | — | — | — | — | |
| 新竹矮脚尖 | 分蘗數 | 7.3 | 12.6 | 17.1 | 16.3 | 16.4 | 16.4 | 14.8 | 14.2 |
| | 增減數 | | 5.3 | 4.5 | −0.8 | 0.1 | 0 | −1.6 | |
| | 百分比（%） | 42.69 | 73.68 | (100) | — | — | — | — | |
| 嘉農秈11號 | 分蘗數 | 9.8 | 16.7 | 21.7 | 20.1 | 21.1 | 19.5 | 18.0 | 16.3 |
| | 增減數 | | 6.5 | 5.0 | −1.6 | 1.0 | −1.6 | −1.5 | |
| | 百分比（%） | 45.16 | 76.96 | (100) | — | — | — | — | |

移植後第10週）及14日（移植後第10週），新竹矮脚尖一期作爲5月28日（移植後第11週），二期作10月10日（移植後第9週），嘉農秈11號爲5月30日抽穗（移植後第11週），二期作爲10月15日（移植後第10週）。由此觀之，稻品種之全乾物重，最高增加率發生時期大致在抽穗前後，而新竹矮脚尖在第二期作之最高增加率，顯示有二個高峰，一發生於插秧後的第7週，另一則發生於第9週，而此現象並未發生於第一期作或其他供試驗品種。同時，不論品種爲何，全乾物重增加率達到最高峰後，隨後一週的增加率則頗低，但隨之增高，增加的大小則隨品種而異。

四、期作對不同類型水稻品種主要農藝性狀及榖產量之影響：主要農藝性狀，經調查結果如表3，稻穀產量變方分析如表4，自表3，不論其爲秈稻或稉稻，就供試的六個品種言，一期作之稈高均高於第二期作，如 Todorokiwase 一期作稈高爲109.5cm，二期作則爲 86.9 cm，相差20.6%左右，在供試驗的6個品種中，臺農38號是最高的一個品種，其第一期作稈高爲 136.5cm，第二期作

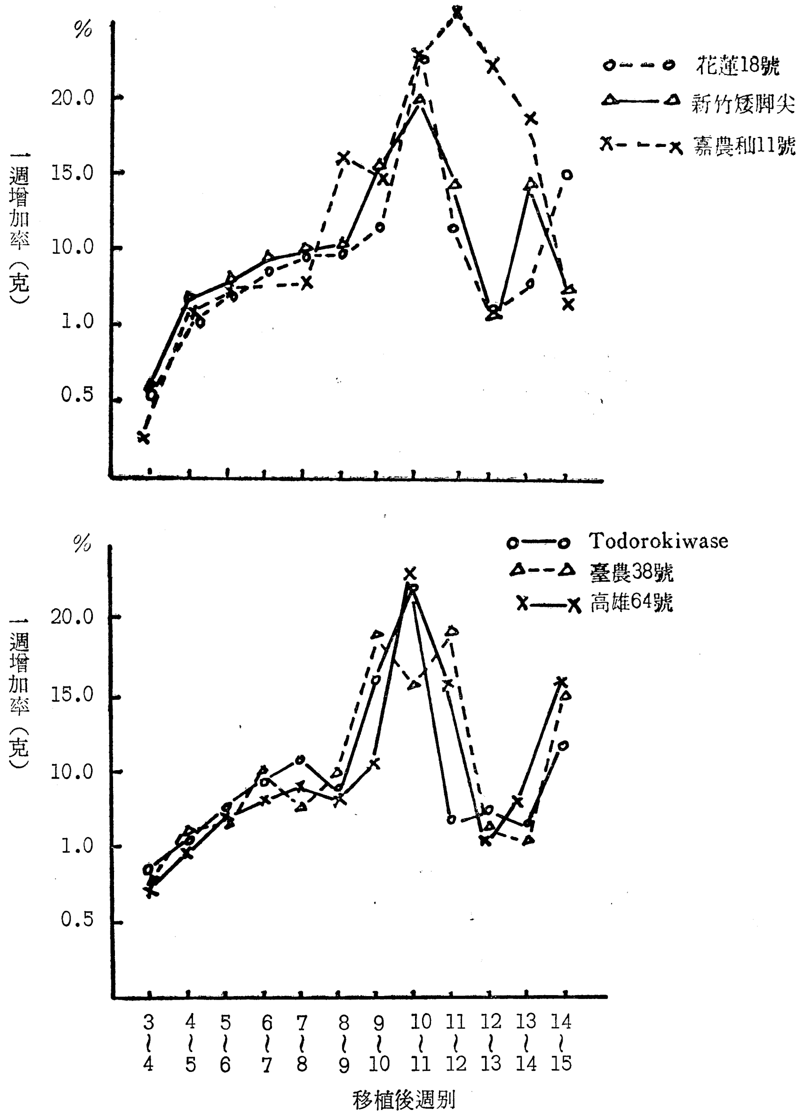


圖2 A． 期作對不同類型水稻品種全乾物重消長趨勢（第一期作）

降爲 115.3 cm 相差15.5%左右，半矮性秈稻品種如嘉農秈11號，一期作爲 85.6 cm，二期作爲71.1 cm。穗數一般來說，第一期作均多於第二期作，但品種間的差異有別，如高雄64號相差 27.1 %爲供試驗品種中之最高者，次爲 Todorokiwa (21.5%) ，花蓮18號 (14.8%) 及臺農38於 (7.8%) 。新竹矮脚尖一、二期作之差異僅 4.1%左右，而以嘉農秈11號表現最優，一、二期作無差異。每穗粒數，一、二期作的差異以 Todorokiwase 之24.8% 最大，次爲臺農38號，高雄64號，新竹矮脚尖，分別爲12.4%、10.5%、8.4%，而以嘉農秈11號之3.2%最低。千粒重一、二期作之差異以新竹矮脚尖之差異最大 (15.2%) ，嘉農秈11號最低 (4.7%) ，結實率則以嘉農秈 11號一、二期作之差異最大 (16.1%) ，次爲新竹矮脚尖 (6.2%) 臺農38號最低(1.5%)一般來說，秈稻在第二期作之環境下，結實率均較稉稻差。單位面積的乾穀重，一、二期作的差異，以 Todorokiwase 最大 (減產30%) ，臺農38號及高雄 64號次之 (分別減產21.3及21.5%) 新竹矮脚尖及嘉農秈11號居三(分別減產17.4

及15.7%）以花蓮18號減產8.3%最少。

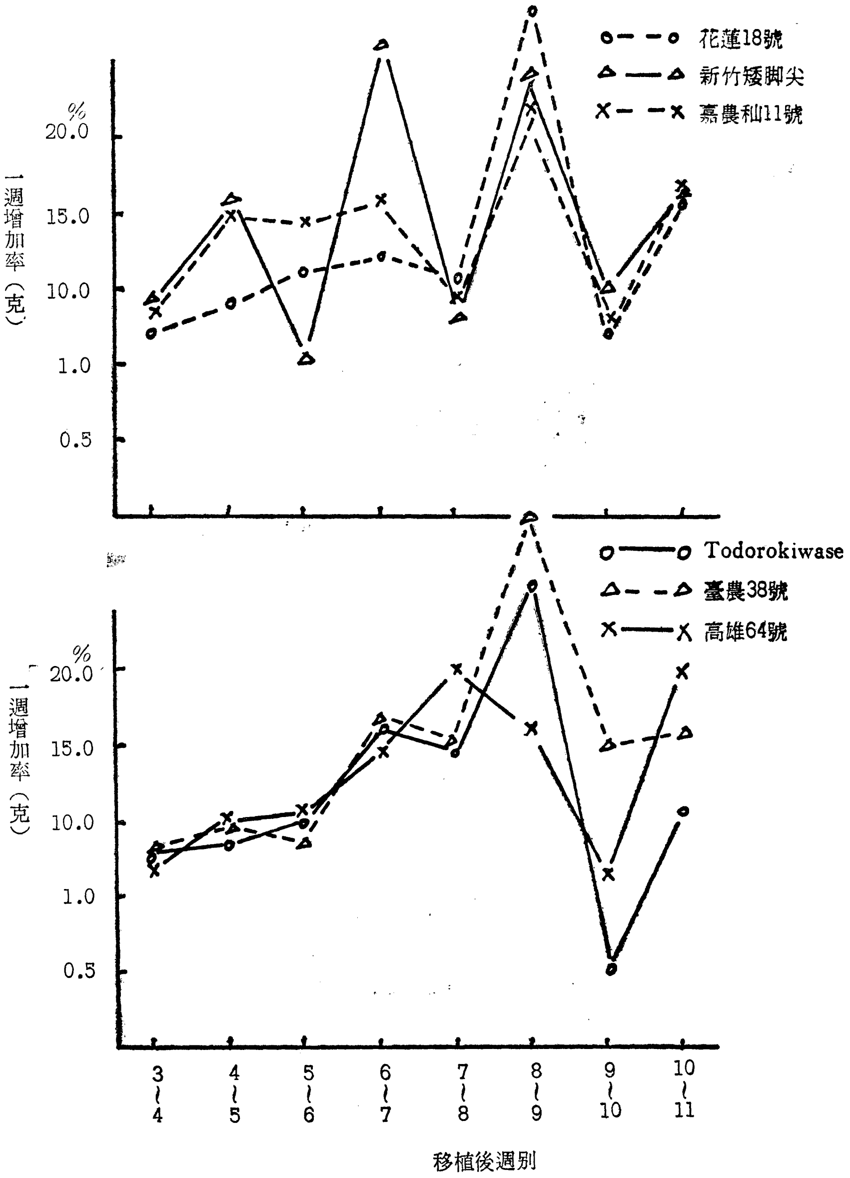


圖2 B．期作對不同類型水稻品種全乾物重消長趨勢（第二期作）

## 表3. 供試品種主要農藝性狀及穀產量一、二期作之差異

| 品種 | 期作 | 稈長 | 穗數 | 穗長 | 每粒穗數 | 千粒重 | 結實率 | 藁重(克/5m²) | 穀重(克/5m²) |
|---|---|---|---|---|---|---|---|---|---|
| Todorokiwase | I | 109.5 | 18.1 | 15.5 | 82.3 | 24.8 | 94.3 | 2072.5 | 2482.5 |
| | II | 86.9 | 14.2 | 15.1 | 61.9 | 23.6 | 90.5 | 1188.5 | 1737.5 |
| | 差異（%） | 20.64 | 21.54 | 2.58 | 24.78 | 4.83 | 4.03 | 42.65 | 30.01 |
| 臺農38號 | I | 136.5 | 11.6 | 20.7 | 122.6 | 25.3 | 86.2 | 2720.0 | 2660.0 |
| | II | 115.3 | 10.7 | 20.3 | 107.4 | 22.8 | 84.9 | 1625.0 | 2092.5 |
| | 差異（%） | 15.53 | 7.76 | 1.93 | 12.40 | 9.88 | 1.51 | 40.26 | 21.33 |
| 高雄64號 | I | 135.3 | 12.9 | 21.1 | 124.4 | 25.0 | 88.8 | 2867.5 | 2632.5 |
| | II | 113.5 | 9.4 | 20.9 | 111.3 | 22.9 | 84.0 | 1642.5 | 2067.5 |
| | 差異（%） | 16.11 | 27.13 | 0.95 | 10.53 | 8.4 | 5.41 | 42.72 | 21.46 |
| 花蓮18號 | I | 134.6 | 12.5 | 21.8 | 128.5 | 5.0 | 83.0 | 2540.0 | 2392.5 |
| | II | 113.9 | 11.2 | 21.5 | 123.3 | 23.1 | 79.8 | 1645.0 | 2195.0 |
| | 差異（%） | 15.38 | 10.40 | 1.38 | 4.05 | 7.6 | 3.86 | 35.24 | 8.25 |
| 新竹矮脚尖 | I | 91.8 | 14.8 | 18.8 | 109.7 | 23.1 | 87.4 | 2022.5 | 2222.5 |
| | II | 75.7 | 14.2 | 17.5 | 100.5 | 19.6 | 82.0 | 1725.0 | 1835.0 |
| | 差異（%） | 17.54 | 4.05 | 6.91 | 8.39 | 15.15 | 6.18 | 14.71 | 17.44 |
| 嘉農穗11號 | I | 85.6 | 16.3 | 18.2 | 94.8 | 21.2 | 85.3 | 2270.0 | 2482.6 |
| | II | 71.1 | 16.3 | 17.8 | 91.8 | 20.2 | 71.6 | 2007.5 | 2092.5 |
| | 差異（%） | 16.94 | 0 | 2.20 | 3.16 | 4.72 | 16.06 | 11.56 | 15.71 |

稻穀產量之變方分析如表4第一期作品種間差異達顯著程度，供試6個品種中以臺農38號產量最高(5.3 t/ha)，次爲高雄64號 (5.2 t/ha)，Tcdorokiwase 及嘉農秈11號，公頃產量均爲4.9噸，而以新竹矮脚尖公頃產量最低 (4.4噸)。第二期作，品種間差異達極顯著程度，供試驗品種中以花蓮18號產量最高 (4.3 t/ha)，臺農38號及嘉農秈11號次之 (4.1 t/ha)，高雄64號居三 (4.1 t/ha) 而以 Todorokiwase 公頃產量3.4噸最低。

## 表 4. 變方分析表

| 變因 | 均方 | | F值 | |
|---|---|---|---|---|
| | 一期作 | 二期作 | 一期作 | 二期作 |
| 區集 | 44337.5 | 19722.22 | | |
| 品種 | 103697.5 | 124606.66 | 3.96* | 5.07** |
| 機差 | 26210.8 | 24595.56 | | |

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# Studies on the Growth Pattern of *Indica* and *Japonica* Rices as Influence by Crop Seasons[1]

By

S. M. Chiu

## Summary

Plant type and growth pattern are known to be closely related with the physiological status which will effects directly to the yield of rice. The present studies are aimed to investigate the growth pattern and yield components of *Japonica*-and *indica*-type rices as influence by crop seasons. The results of the research findings are summarized in the followings :

1. The growth rate of semi-dwarf varieties was larger in the early stage than the later stage of growth, however, the opposite was true for the long-culmed *japonica* type varieties, but in the second crop season, it was larger in the early stage than in the later stage in the both types of varieties. The *japonica* type varieties were found to be more sensitive to the enviromental conditions of second crop within the materials used.

2. Under the first crop season, no remarkable difference in the tillering numbers at the early stage between *indica* and *Japonica* varieties was observed. The No. of tillers increased rapidly thereafter and reached its maximum 5-6 weeks after tansplanting. The period developing tillers remain as long as one month. In the second crop season it took only 7-10 days to reach the maximum tillering stage. It was observed also that the

1. Contribution No. 838 from the Taiwan Agricultural Research Institute.

*indica* type varieties have more effective tillers than the *japonica* type varieties.

3. Yield components differ remarkably between *japonica* and *indica* rices and also between different crop seasons. In general, the larger values were observed with the first crop season. For example, the *japonica* type varieties Kaohsiung 64 and Todorodiwase showed 27% and 21.5% increase in panicle per hill in the first crop than that in the secon crop. The *indica* type variety Hsinchu Ai-chiao-chien showed a smaller value (4.1%)of increment and no difference was observed for Chianung-sen 11 between the two crops.

4. Todorokiwase showed 24.8% more number of grains per panicle in the first crop than the second crop ofllowed by Tainung 33(12.4%), Kaohsiung 64(10.5%)and Hsinchu Aichiao-chien (8.4%) . Hsinchu Ai-chiao-chien showed 15.2% higher in 1,000 grain weight in the first crop than that in the second crop, while Chianung-sen 11 was 4.7% more in the first crop.

5. Varietal difference in the degree of yield decrease in the second crop than of first crop was observed which were in the order of Todorokiwase (30%), Tainung 38 (21.3%) Kaohsiung 64 (21.5%) , Hsinchu Ai-chaio-chien (17.4%) , Chianung-sen 11 (15.7%) and Hualien 18 (8.3%) respectively.

# EFFECT OF HOT-AIR TREATMENT ON LIKUBIN. TRISTEZA VIRUS AND EXOCORTIS VIROID DISEASES OF CITRUS[1]

Chiou-hsiung Huang[2]

**Abstract**: Buds from likubin diseased citrus trees were grafted to rangpur lime seedlings. They were exposed to alternate temperatures of daytime ca. 40°C for 16 hr and nighttime 30° C for 8hr for a period of 4 weeks or longer, such treated plants produced no likubin symptoms in new growth after two-year period of observation. All treated plants indexed in mexican lime seedlings showed tristeza virus symptoms. These results indicated that the main component of likubin pathogen was inactivated, but the tristeza virus was not completely inactivated. Young shoots from tristeza-infected mexican lime seedlings which had been placed at 40/30°C for 15 weeks or 39-45/29-33°C for 10 weeks could be free from tristeza virus. Temperatures at 38/28°C was not sufficient for virus inactivation. None of hot-air treated cuttings were free from exocortis pathogen even the treatment was prolonged up to 52 weeks.

## Introduction

Heat therapy has been extensively used for the elimination of graft transmissible pathogen in citrus (1, 10) and many other perennial plants (8) . Early in 1941, Fawcett and Cochran (3) reported that the resistance of citrus tissue and psorosis virus A to heat. Their results indicated that hot water treatment had no direct practical value for virus inactivation. Similar results were also reported by Grant in 1957 (6) . Hot-air treatment, on the other hand, was reported to be efficient for obtaining some virus-free sources of citrus by many workers (1, 5, 10). Desjardins et al (4) stated that tristeza virus symptoms were suppressed when the infected mexican lime seedlings were held for a period of 3—4 weeks at 40°C. Moreover, placing the infected plants at 98—104°F for 86—100 or more days were sufficient for getting psorosis-and tristeza-free tissues (5) .

Recently, Calavan et al (1) found that alternating temperatures were superior to constant temperature for plant survival as well as for virus inactivation. Since virus and virus-like diseases of citrus have been widespread and become important in Taiwan,

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2. Plant Pathologist, Department of Plant Pathology, Taiwan Agricultural Research Institute.

it is of urgent need to obtain disease-free budwood sources for commerical uses. The purpose of this study was to realize a suitable hot-air treatment method for obtaining likubin-tristeza- and exocortis-free budwood sources for the establishment of the citrus variety improvement program in Taiwan.

## Materials and Methods

Two types of thermotherapeutic chambers were used in this experiment: one is a 'Hotpack' model 352720 refrigerated incubator and another one is a 2.7m ×2.7m×2.0m woodmade chamber with aluminium-sheathed. The former was divided into two layers with automatic temperature control at ca. 40°C for daytime 16 hr and 30°C for nighttime 8 hr in the upper layer and about 38/28°C in the lower layer. The latter was equipped with heating system with maximum temperatures at 39—45/29—33°C in summer season.

Sources of likubin-infected budwood were collected from 10-year-old ponkan and tankan trees in Taichung and Chiayi orchards. About 2 diseased buds were bud-grafted to a healthy rangpur lime seedling and placed in the thermotherapeutic chamber one week after graft inoculation. 35 seedlings were treated with various intervals and then removed to the greenhouse. The seedlings with survived buds were then forced to develop new growth and reindexed in suitable indicator plants.

The tristeza-infected mexican lime and exocortis-infected rangpur lime seedlings were held in heat chamber. After treated with different intervals, young shoots about 1 cm in length with 2 new developing leaves were taken and grafted onto suitable size of indicator plants to determine the presence of virus in selected tissue. Observation for symptom development was continued at least for one year.

## Results

I. Effect of hot-air treatment on diseased buds of likubin complex.

23 out of 35 rangpur lime seedlings were with buds survived. The results are summarized in Table 1. In general, new growth from diseased buds grew very vigorous and healthy after a period of hot-air treatment, but these plants indexed in mexican lime indicator plants showed tristeza virus symptoms. Likubin-diseased buds without any treatment produced typical symptoms 4—5 months after graft inoculation.

2. Effect of hot-air treatment on tristeza-infected mexican lime seedlings and exocortis-infected rangpur lime seedlings.

Data are summarized in Table 2. The results indicated that young shoots taken from tristeza-infected seedlings, which had been treated with 40/30°C for 15 weeks or with 39—45/29—33°C for 10 weeks, were free from tristeza. None of plant tissues taken from exocortis-infected seedlings were free from exocortis pathogen under the same temperature conditions.

Table 1. Effect of hot-air treatment on diseased buds of likubin pathogen complex

| Sources | Variety | Period of treatment (weeks) | Temperature (°C) | Results | | |
|---|---|---|---|---|---|---|
| | | | | No. plants with bub survived | No. plants with likubin symptom | No. plants with tristeza virus |
| Chiayi | Ponkan | 4 | 40/30 | 2 | 0 | 2 |
| Taichung | Ponkan | 4 | 40/30 | 4 | 0 | 4 |
| Chiayi | Ponkan | 8 | 40/30 | 2 | 0 | 2 |
| Taichung | Ponkan | 8 | 40/30 | 5 | 0 | 5 |
| Taichung | Ponkan | 13 | 40/30 | 3 | 0 | 1 |
| Taichung | Tankan | 8 | 39—45/29—33 | 4 | 0 | 4 |
| Taichung | Tankan | 18 | 39—35/29—33 | 3 | 0 | 0 |

Table 2. Results of young-shoot (YS) tests for presence of tristeza and exocortis diseases after infected seedlings with various interval hot-air treatment

| Temperature (°C) | Period of treatment (weeks) | Results | |
|---|---|---|---|
| | | No. YS free from tristeza / No. YS survived | No. YS free from exocortis / No. YS survived |
| 38/28 | 15 | 1/3 | — |
| 38/28 | 20 | 4/11 | — |
| 40/30 | 10 | 0/3 | 0/7 |
| 40/30 | 15 | 9/10 | 0/9 |
| 40/30 | 20 | 6/7 | 0/8 |
| 40/30 | 30 | — | 0/6 |
| 40/30 | 52 | — | 0/8 |
| 39—45/29—33 | 10 | 9/10 | — |
| 39—45/29—33 | 16 | 9/9 | 0/7 |
| 39—45/29—33 | 20 | 8/3 | 0/9 |

## Discussion

Likubin (also called Huanglungpin) is the most serious disease of citrus trees in Taiwan. The causal agent was formerly considered to be a virus closely related to tristeza (7) . Recent study revealed that the main component of likubin pathogen was probably mycoplasma-like organisms(2, 14). According to Su et al (14), likubin pathogen was readily inactivated by dipping the diseased scion in hot water at the temperature higher than 48°C for 10 min. Diseased Ponkan and Tankan seedlings treated at 30/40°C on an 8/16 hour cycle for one month showed remarkable recovery by producing healthy

normal shoots (15) . Data from the present tests also showed that diseased buds grafted to rangpur lime seedlings treated at 40/30°C for four weeks or longer showed no likubin symptoms after two-year period of observation. However, the hot-air treated plants indexed on mexican lime seedlings could produce tristeza virus symptoms. If the treatment was prolonged for a period of 13 weeks, the tristeza virus could be inactivated. It indicated that the main pathogen of likubin could be inactivated easier than tristeza virus.

The absence of tristeza virus symptoms in plants grown under warm temperature condition was a masking effect(4, 11). The disease seemed more difficult to be eliminated at warm temperature of 23—40°C maximum in daytime and 25.6°C minimum in nighttime, but a supplemental treatment in hot-moist air at 50°C for 3—7 hours could eliminate seedling yellows-tristeza virus (10) . A heat exposure period of 107 days was sufficient to inactivate the virus in young tissues, but it could not get rid of the entire source plants of tristeza virus (5). The results from the tests showed that most young shoots cut from infected plant treated with 40/30°C for a period of 15 weeks or 39 —45/29—33°C for 10 weeks were free from tristeza virus. Young shoot about 2—3 month old containing 2 new small leaves gave a higher percentage of survival rate. Temperature at 38/28°C seems to be insufficient for inactivation of tristeza virus even if the treatment is prolonged for 20 weeks. Therefore, young shoots developed under warmer temperature condition may show no tristeza symptoms, but soon after the infected plants were removed to greenhouse temperature, tristeza symptoms would reappear on new developing leaves.

The inactivation of exocortis by a combination of heat therapy and shoot-tip propagation had reported by Stubbs (16) . but the pathogen seemed very tolerant to heat (9) and was a infectious form of free nucleic acid (12, 13) . It remained active from a sweet orange plant treated for 32 weeks at 40/30°C (9). The results from this test confirmed that the heat treatment could not satisfactory inactivate the exocortis pathogen and obtain exocortis -free bud for further propagation.

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# 熱處理對柑桔立枯病、Tristeza及鱗砧病等病原之影響[1]

黃 秋 雄[2]

**摘要**：以感染柑桔立枯病之病穗芽接於二年生健全廣東檸檬幼苗上，每天給於照光16小時40°C/無照光 8 小時30°C之交替溫度處理，經過四週或較長時間處理後，新生枝條均呈現健全，顯示熱處理已將立枯病病原不活化。但若採取此等植物之植株經墨西哥雷木檢定，則可發現有 Tristeza virus 之存在。由是可知。，立枯病主要病原比 Tristeza virus 較易於利用熱處理而使之不活化。

感染Tristeza virus之墨西哥雷木幼苗，同樣置於40/30°C之交替溫度處理，經過 3 至 4 週後，新生雷木葉片上 Tristeza 病徵被抑制，但病毒仍然存在。病植物繼續處理，經過十週，尚未使病原不活化，但延長至15週，則採取之嫩穗，大部份已無 Tristeza 。溫度越高，處理效果越佳，時間亦可縮短，如在 39—45/29—33°C之溫度下處理病植物10週後，即可獲得無 Tristeza病之嫩穗。在植38/28°C下，雖然處理時間長達20週，對 Tristeza 乃然無效。Exocortis 病原對熱抵抗性很强，病物雖然處理時間長達一年，切取之嫩穗乃含有其病原。

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